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Schacht

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(54) **THEFT DETERRENT SKEWER SYSTEMS AND METHODS FOR BICYCLES**

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F16B 41/00 (2006.01)
E05B 71/00 (2006.01)
B62K 25/02 (2006.01)

(52) **U.S. Cl.**
CPC **B62H 5/001** (2013.01); **B62K 25/02** (2013.01); **E05B 71/00** (2013.01); **F16B 41/005** (2013.01); **B62K 2206/00** (2013.01)

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USPC 70/233, 201, 225, 229, 230, 261; 301/124.2; 403/374.5

See application file for complete search history.

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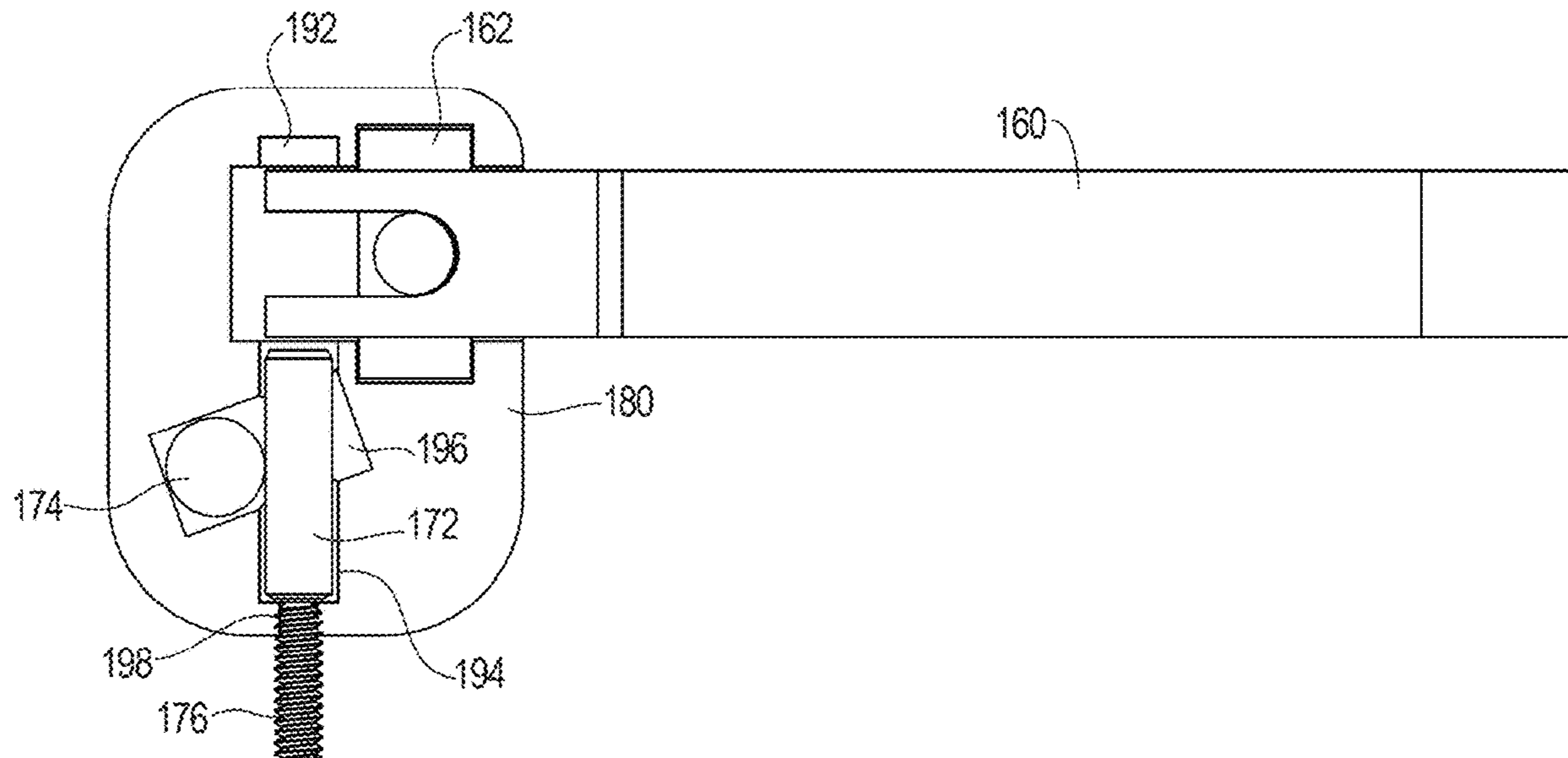
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(57) **ABSTRACT**

A skewer assembly for securing a component to a first portion of a bicycle has a bolt, a housing, and a first lock member. The bolt detachably attaches the component to the first portion of the bicycle. The housing is supported relative to the bolt. The first lock member supported by the housing such that: when the skewer assembly is in an upright orientation, the first lock member inhibits tightening of the bolt; and when the skewer assembly is at least partly displaced from the upright orientation, the first lock member is displaced to allow tightening of the bolt.

19 Claims, 14 Drawing Sheets



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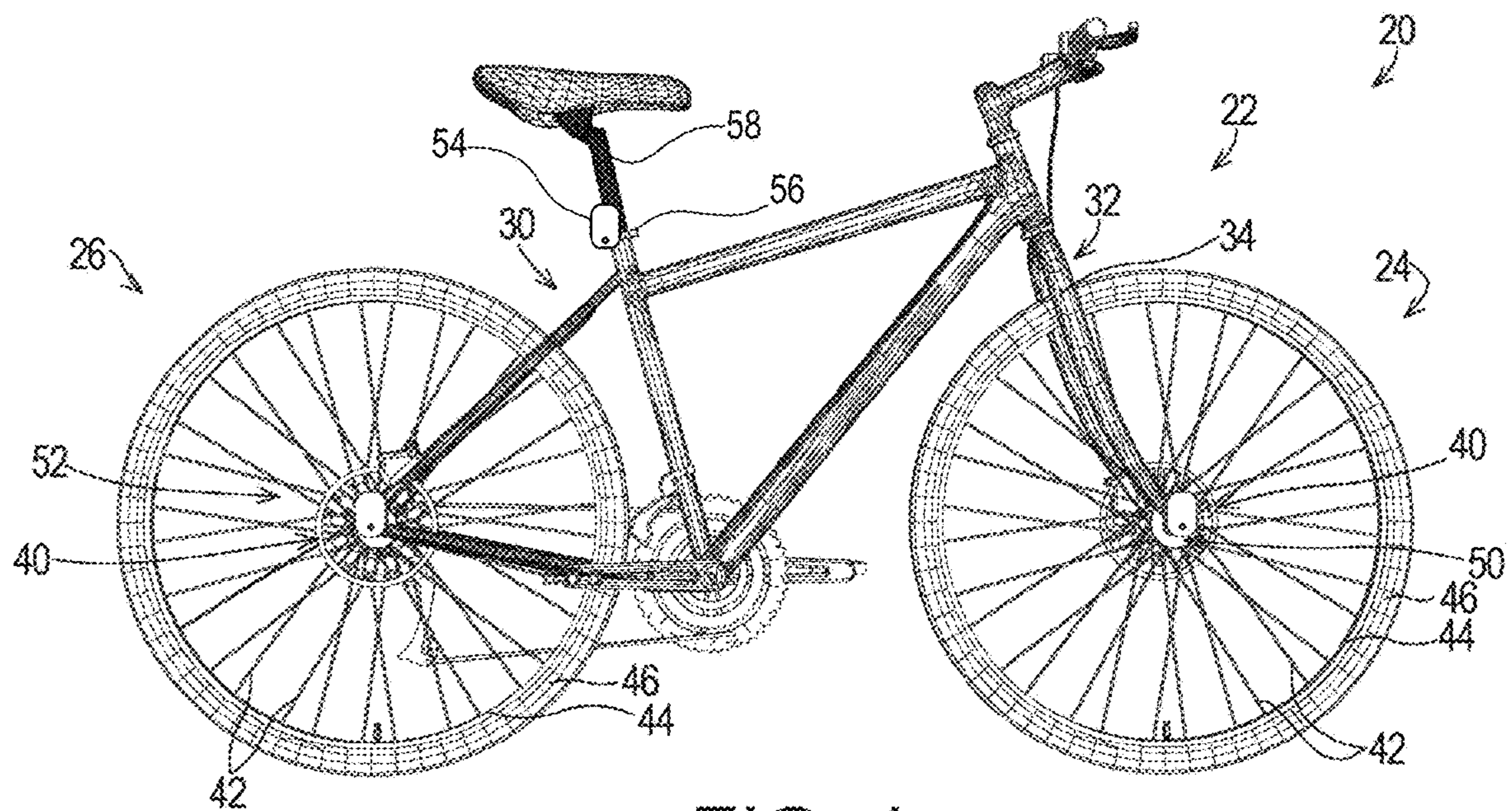


FIG. 1

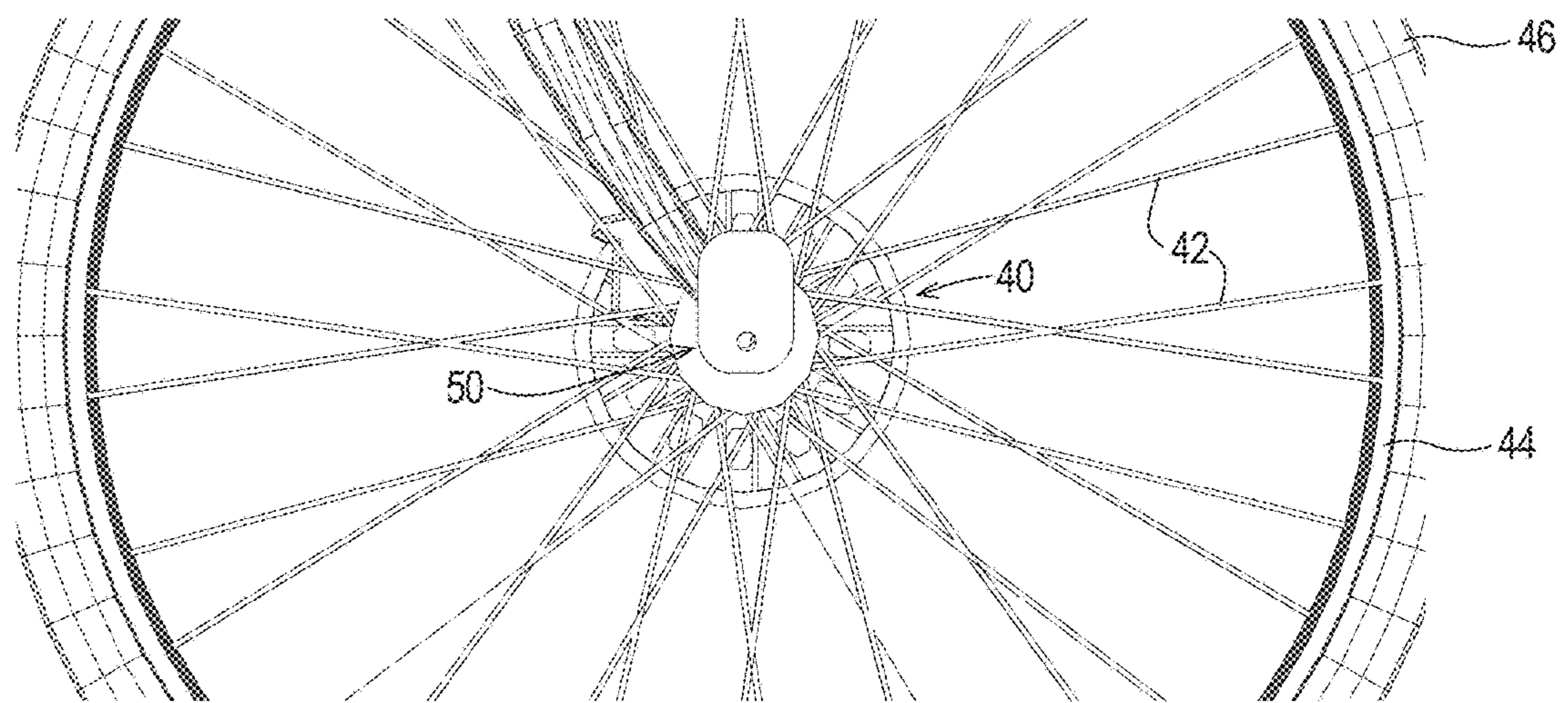
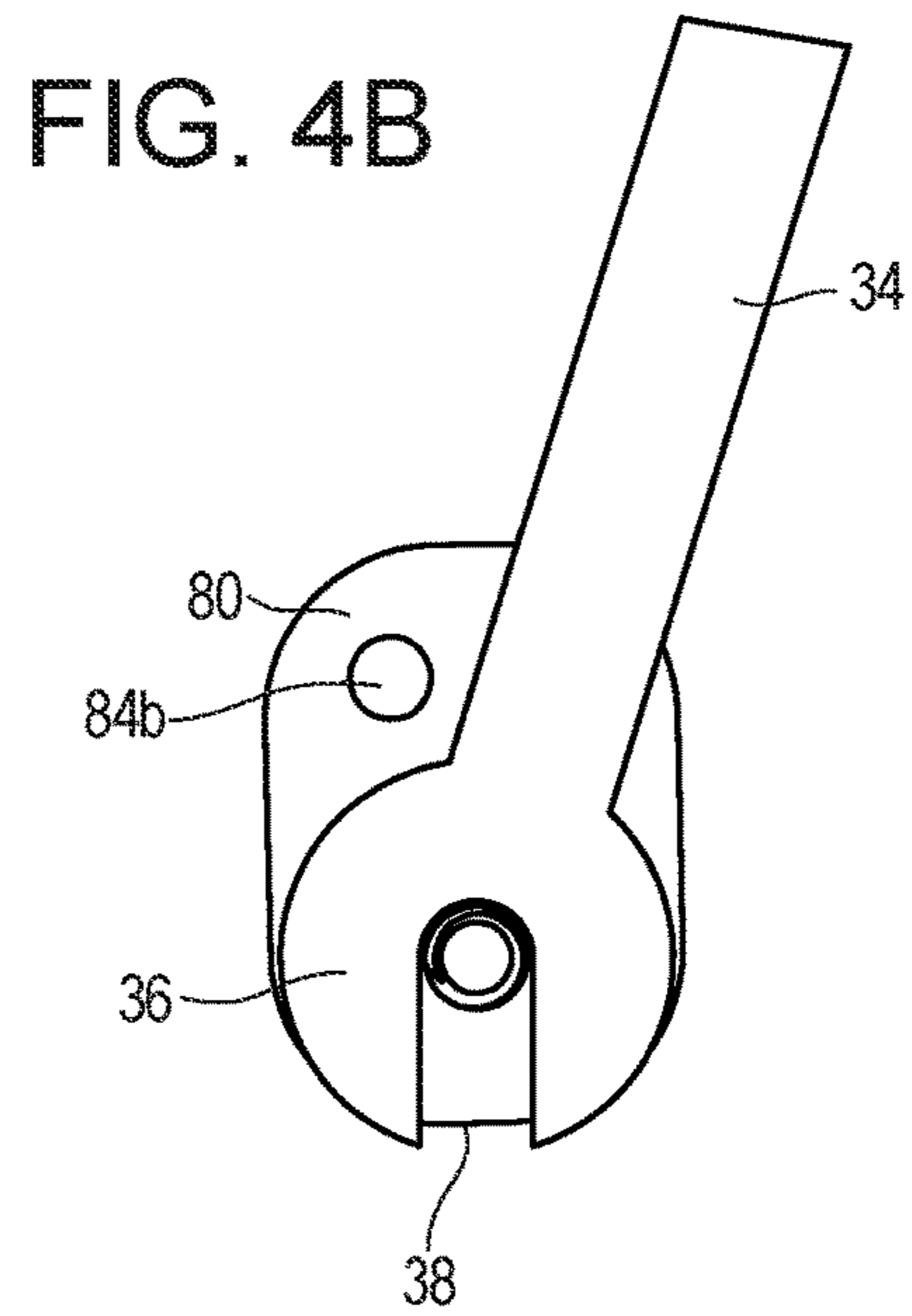
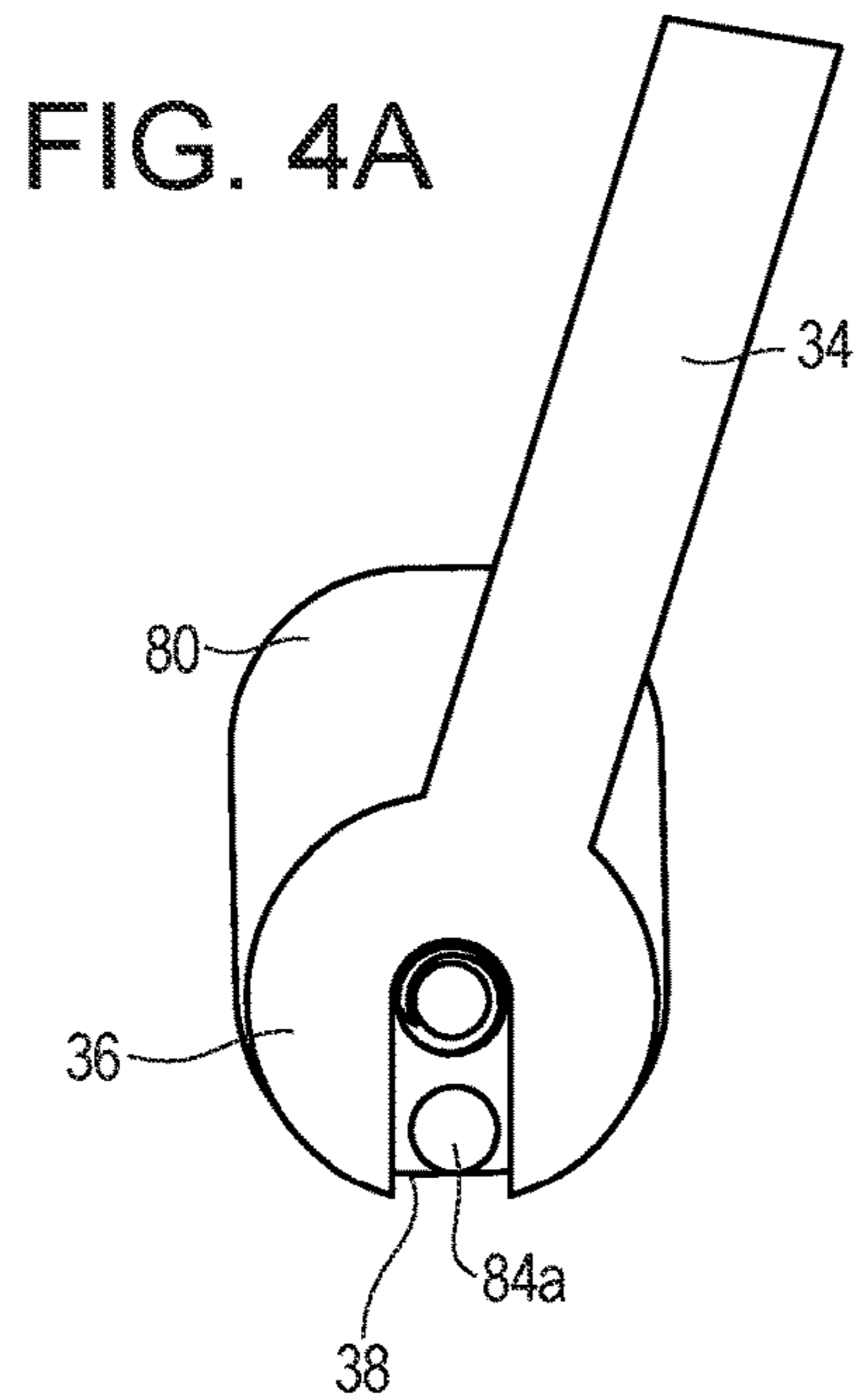
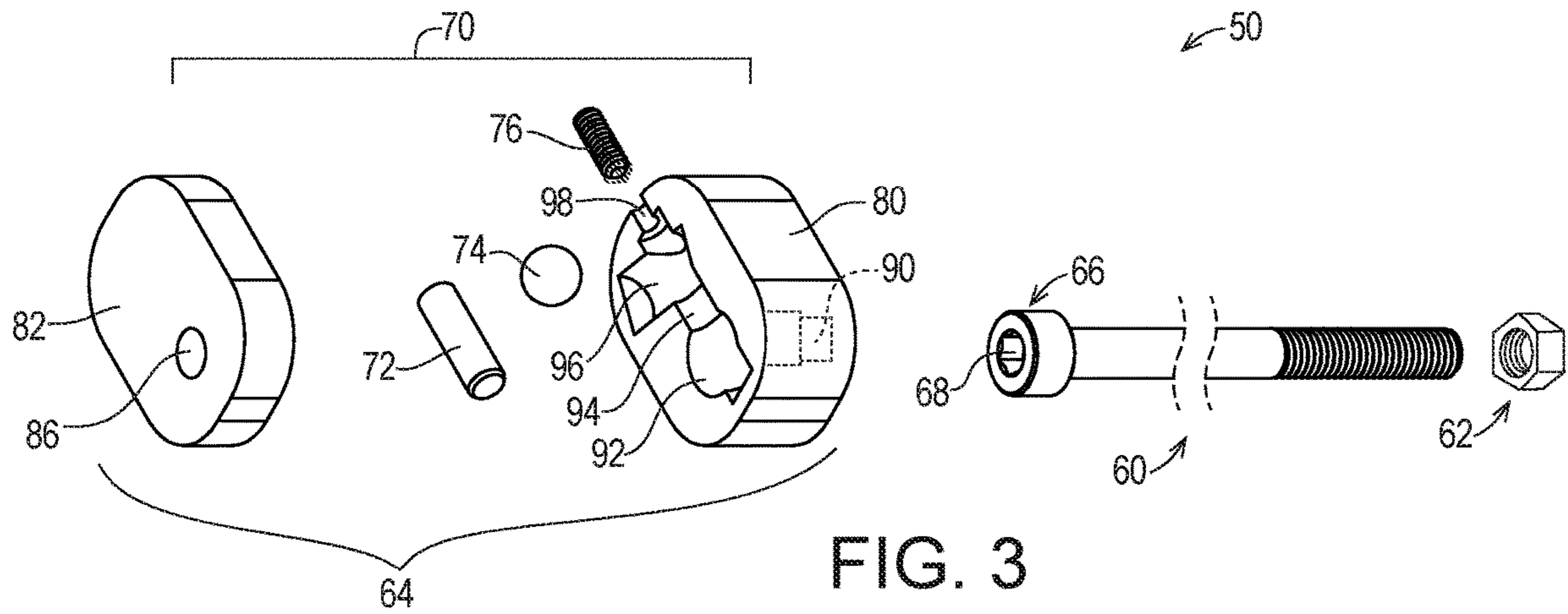


FIG. 2



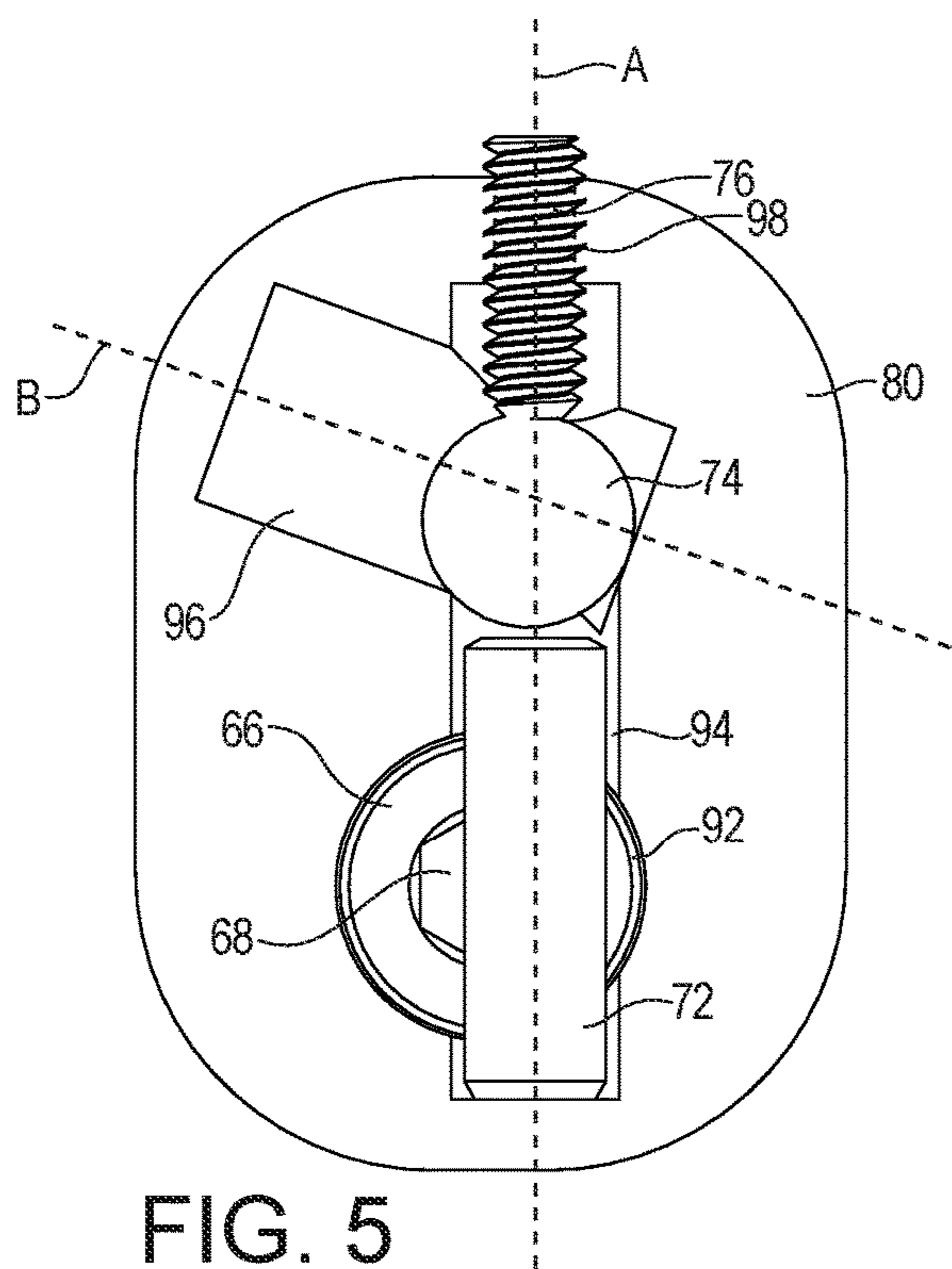


FIG. 5

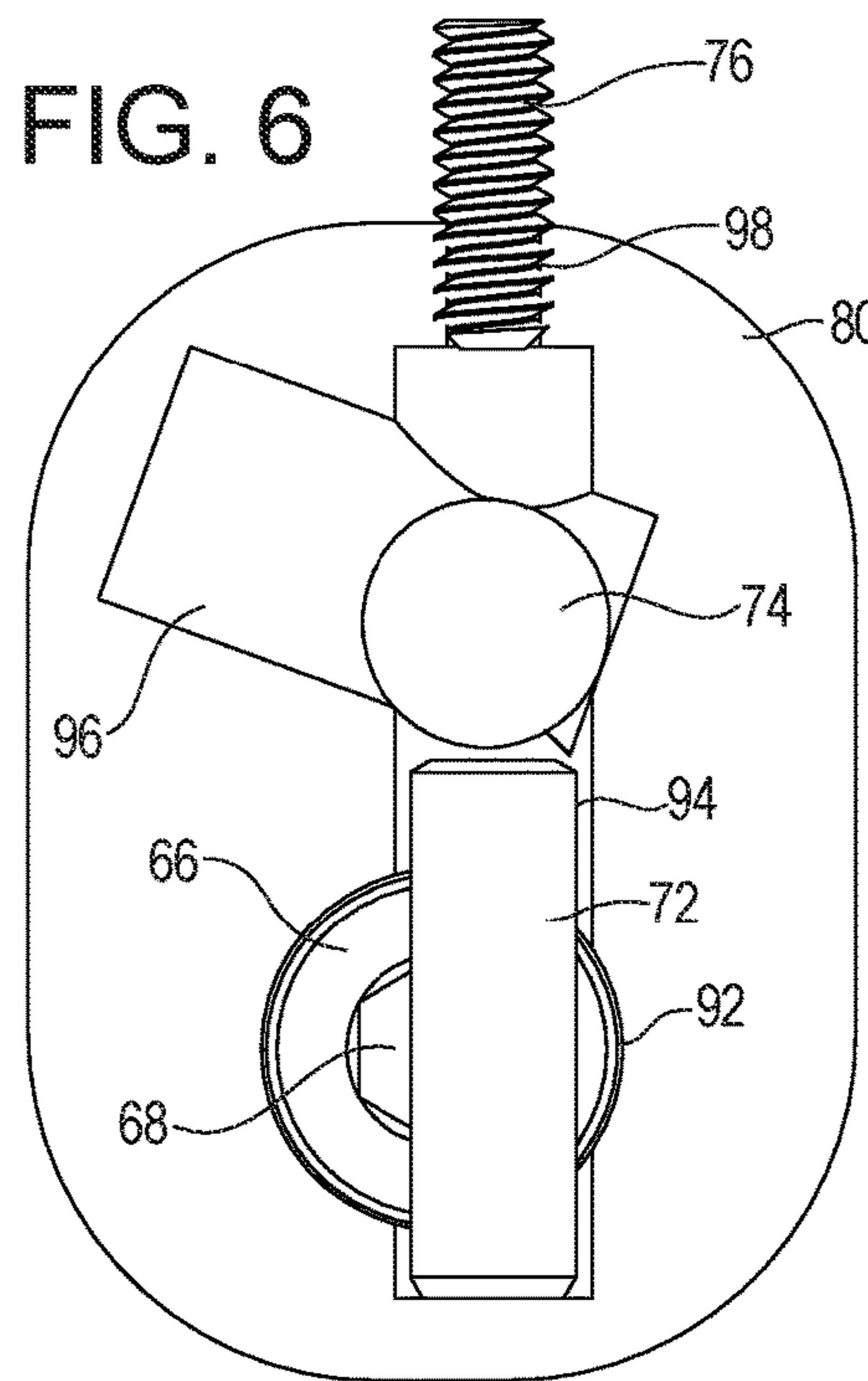


FIG. 6

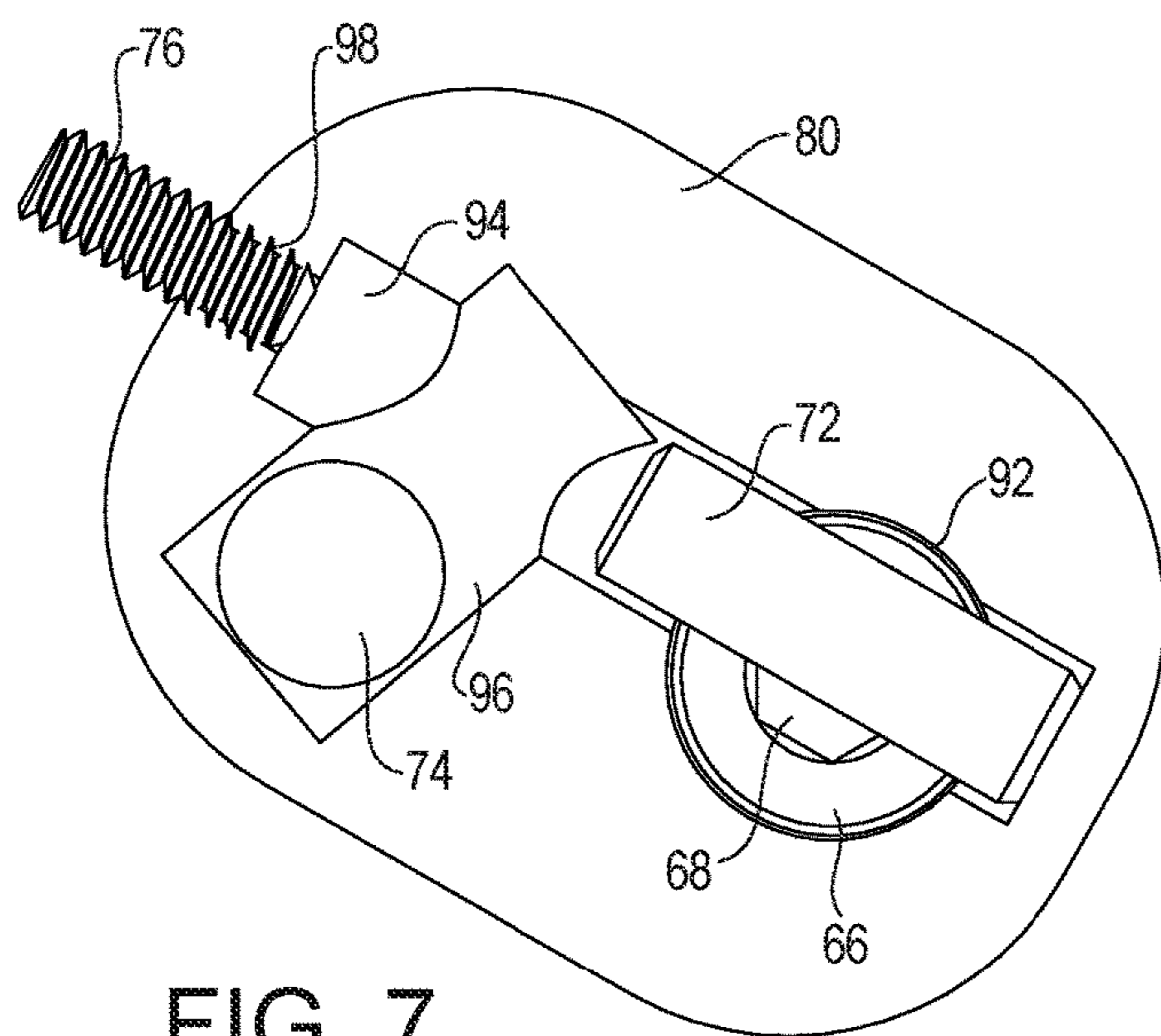


FIG. 7

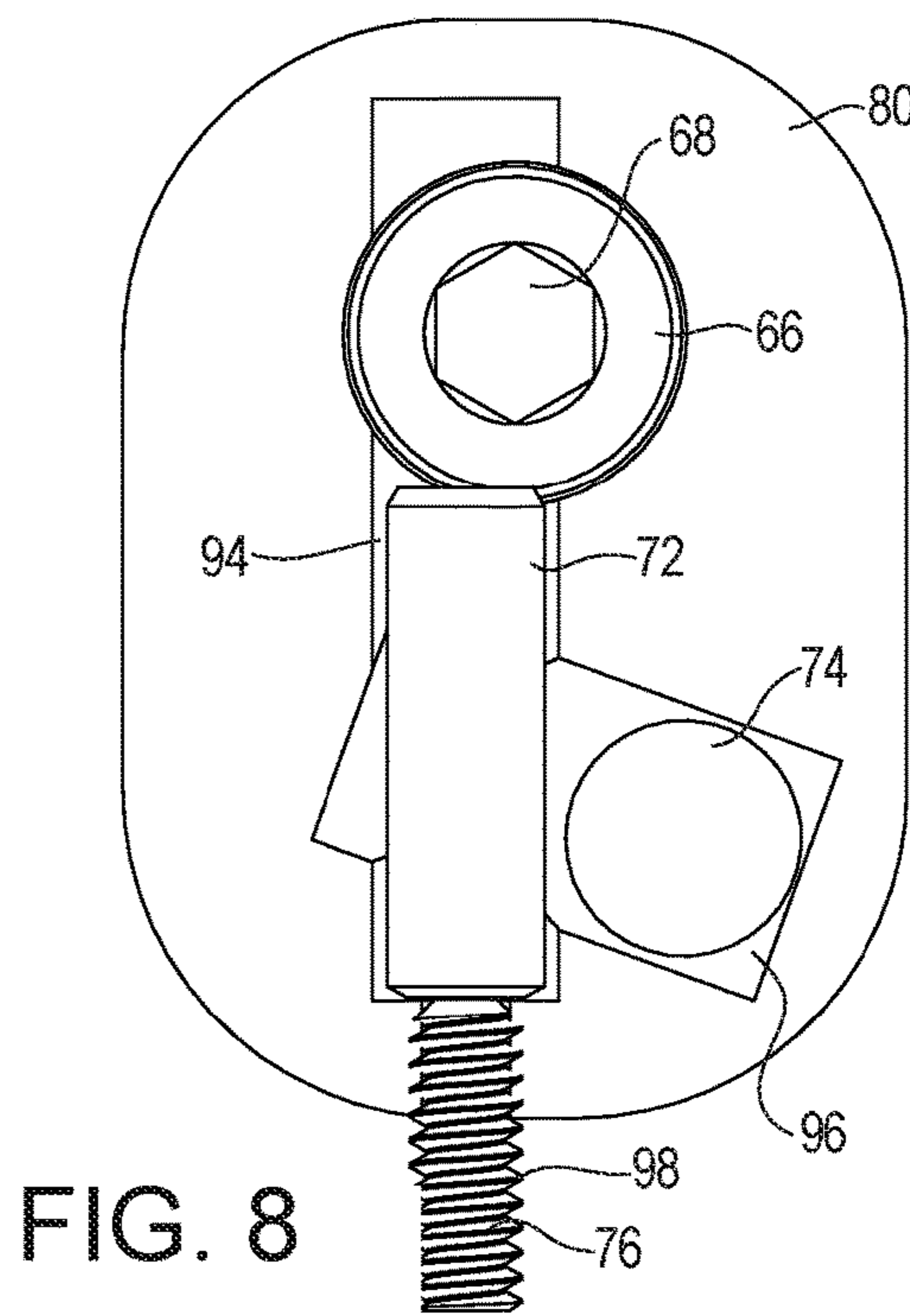


FIG. 8

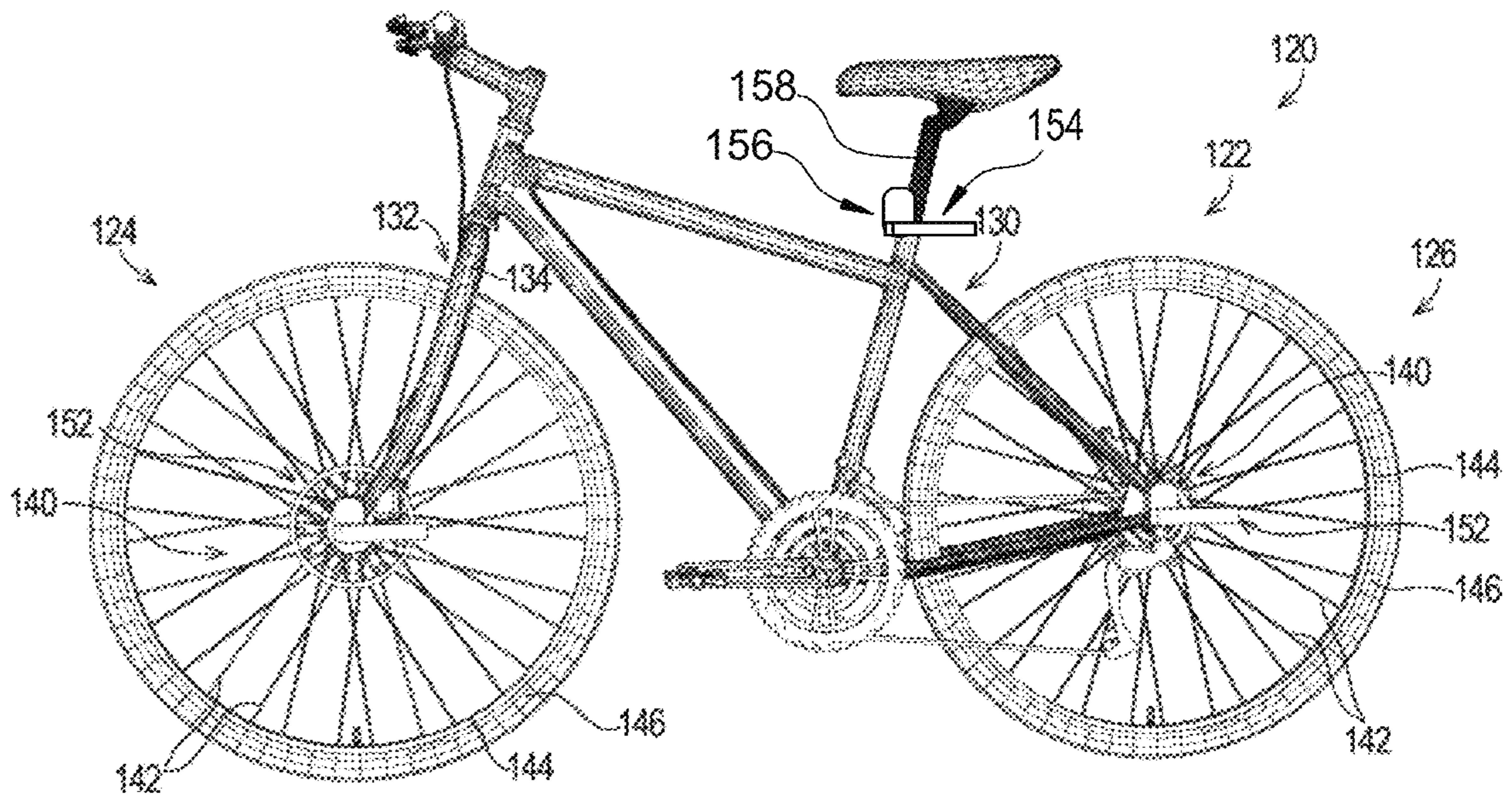


FIG. 9

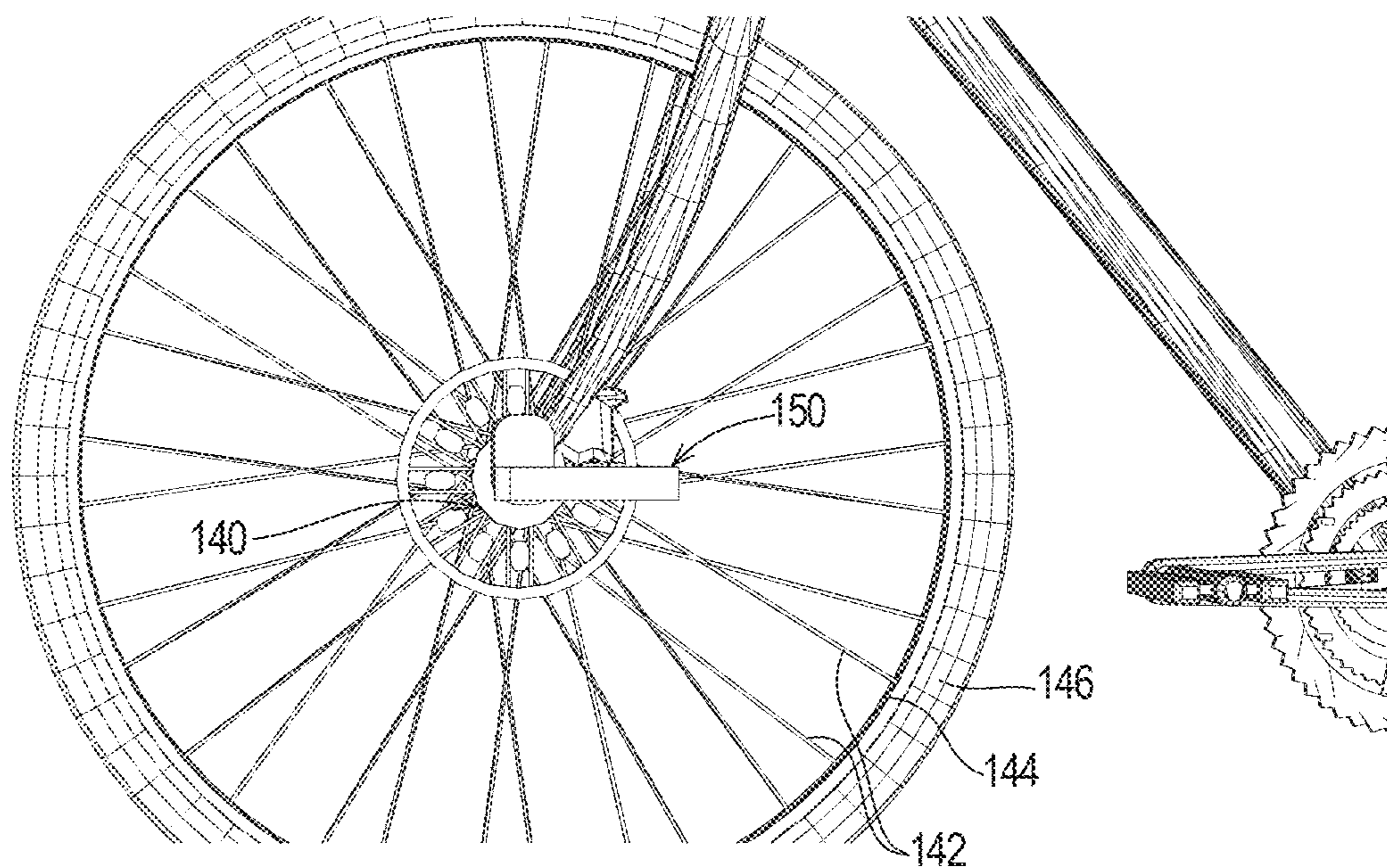


FIG. 10

FIG. 11

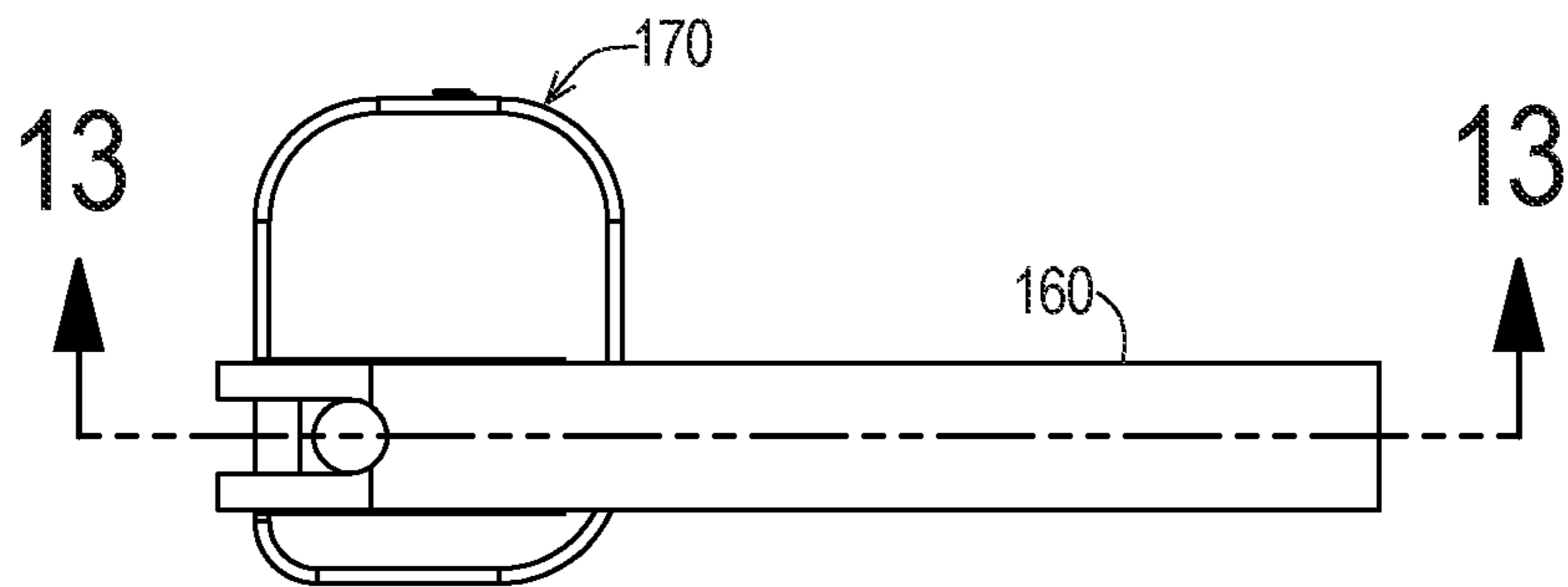
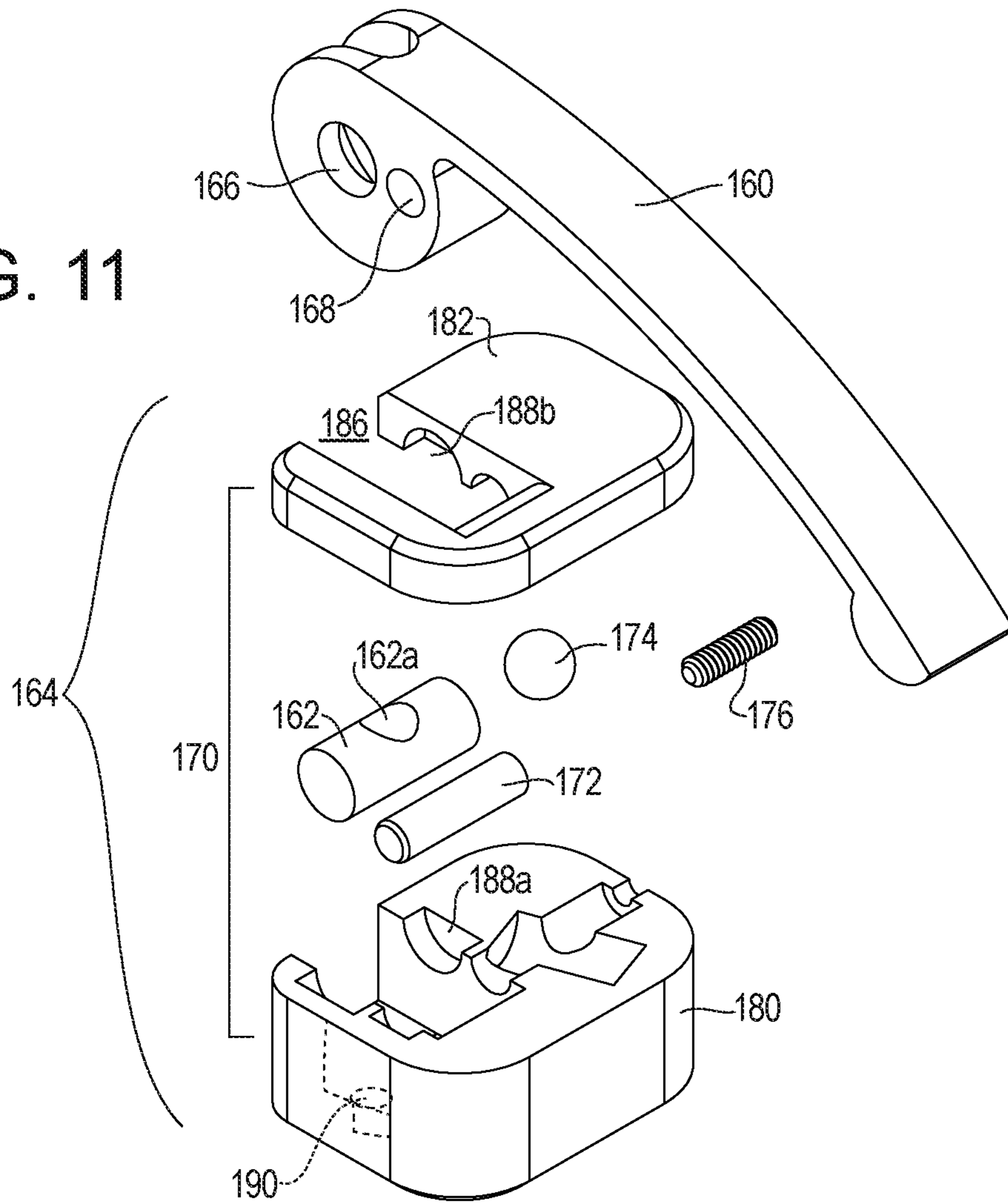


FIG. 12

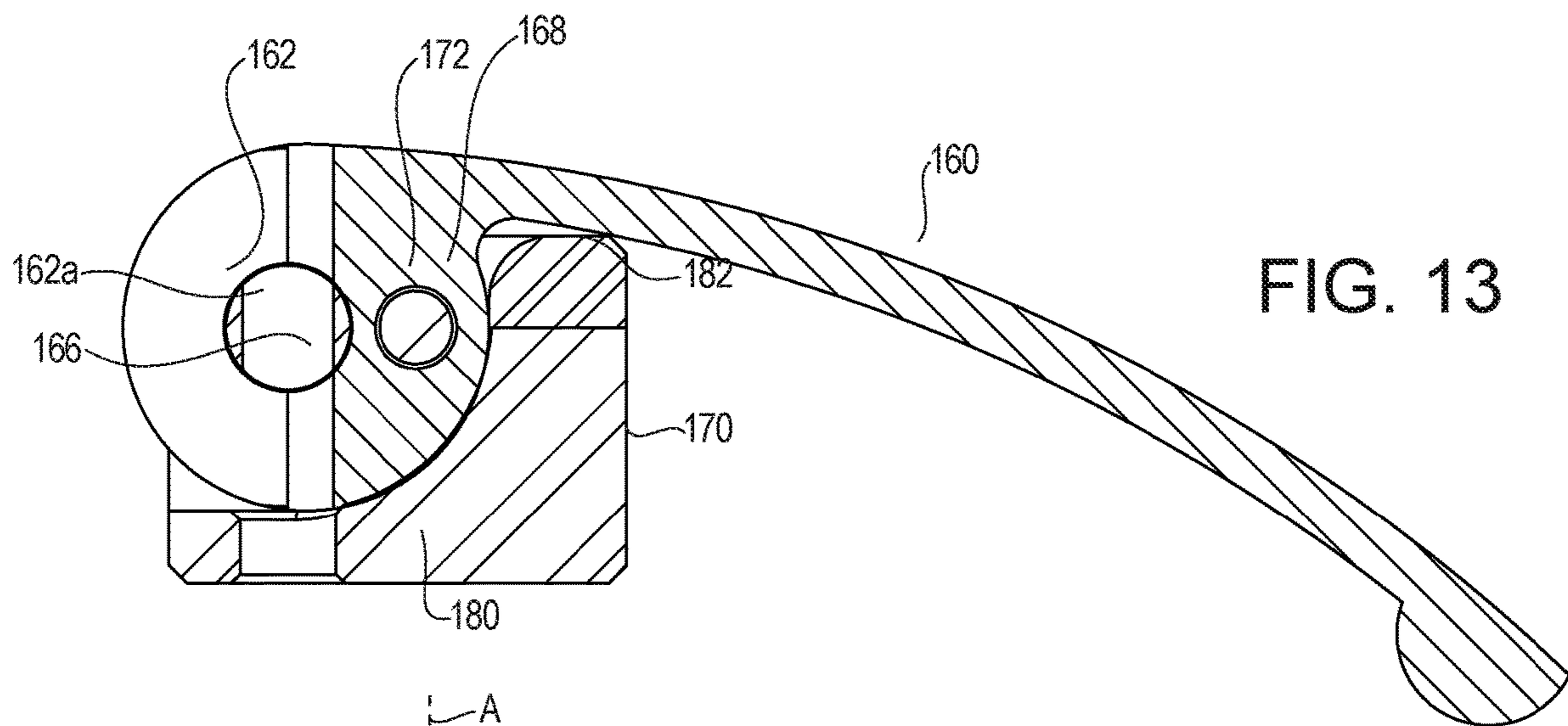


FIG. 13

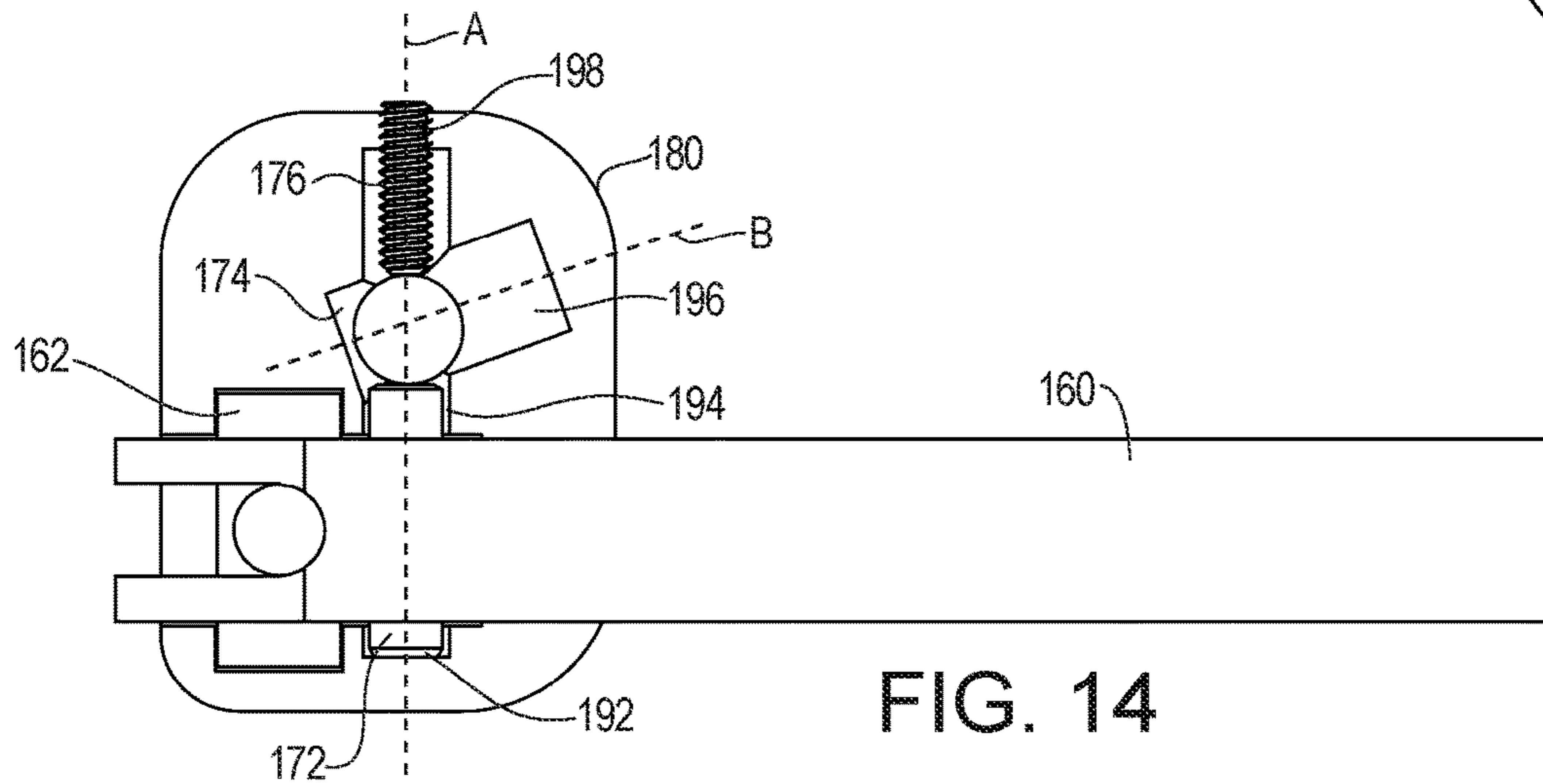


FIG. 14

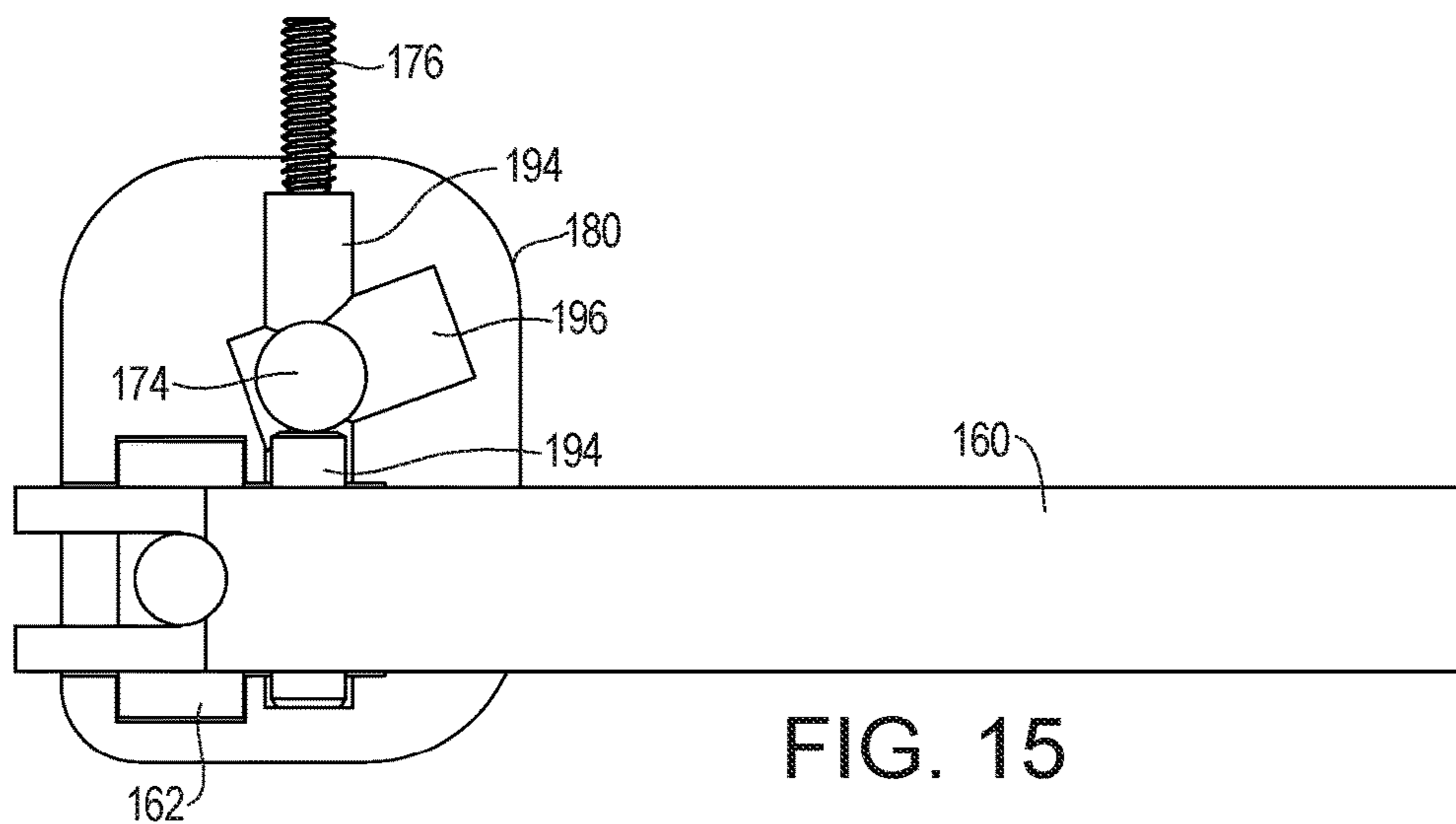


FIG. 15

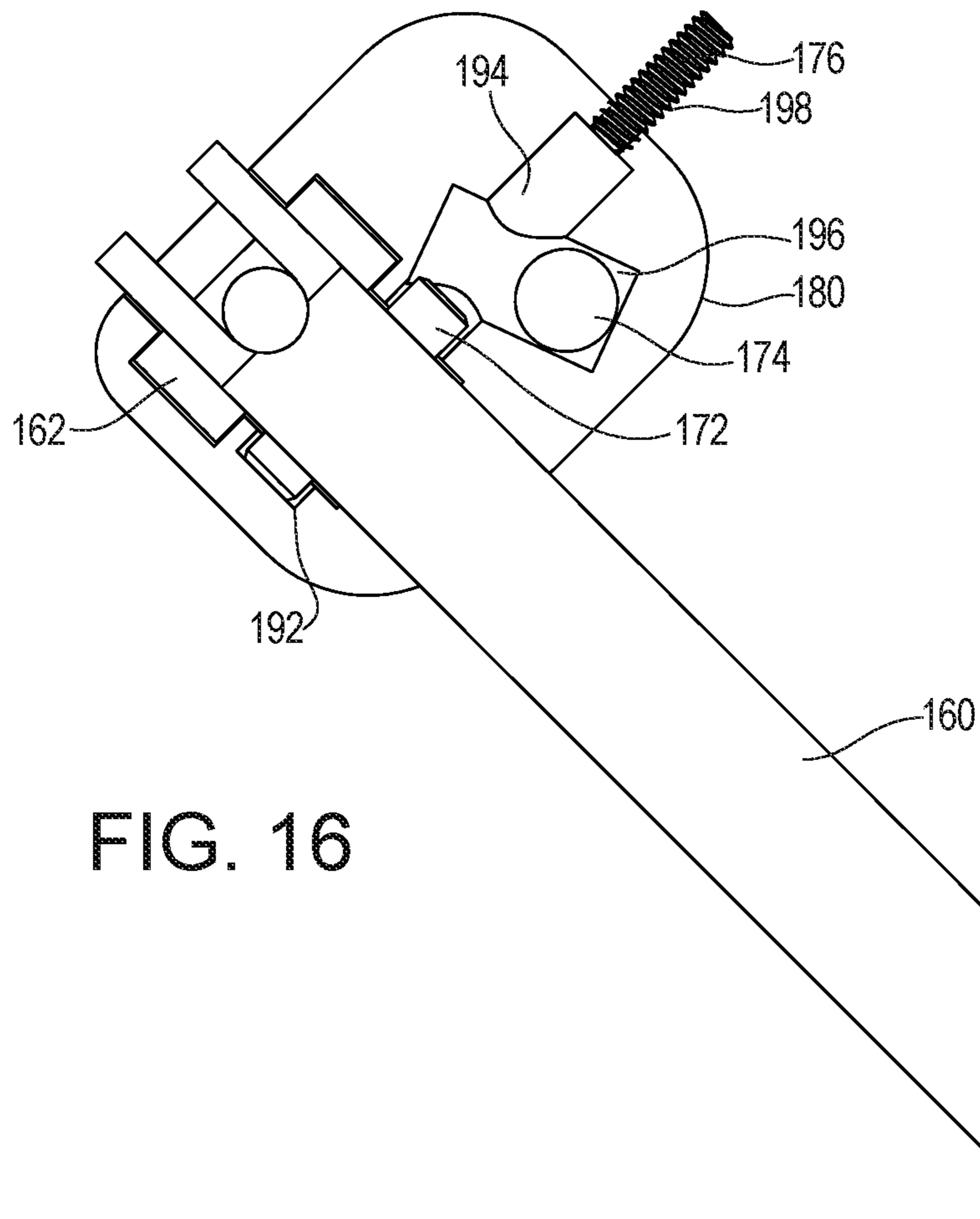


FIG. 16

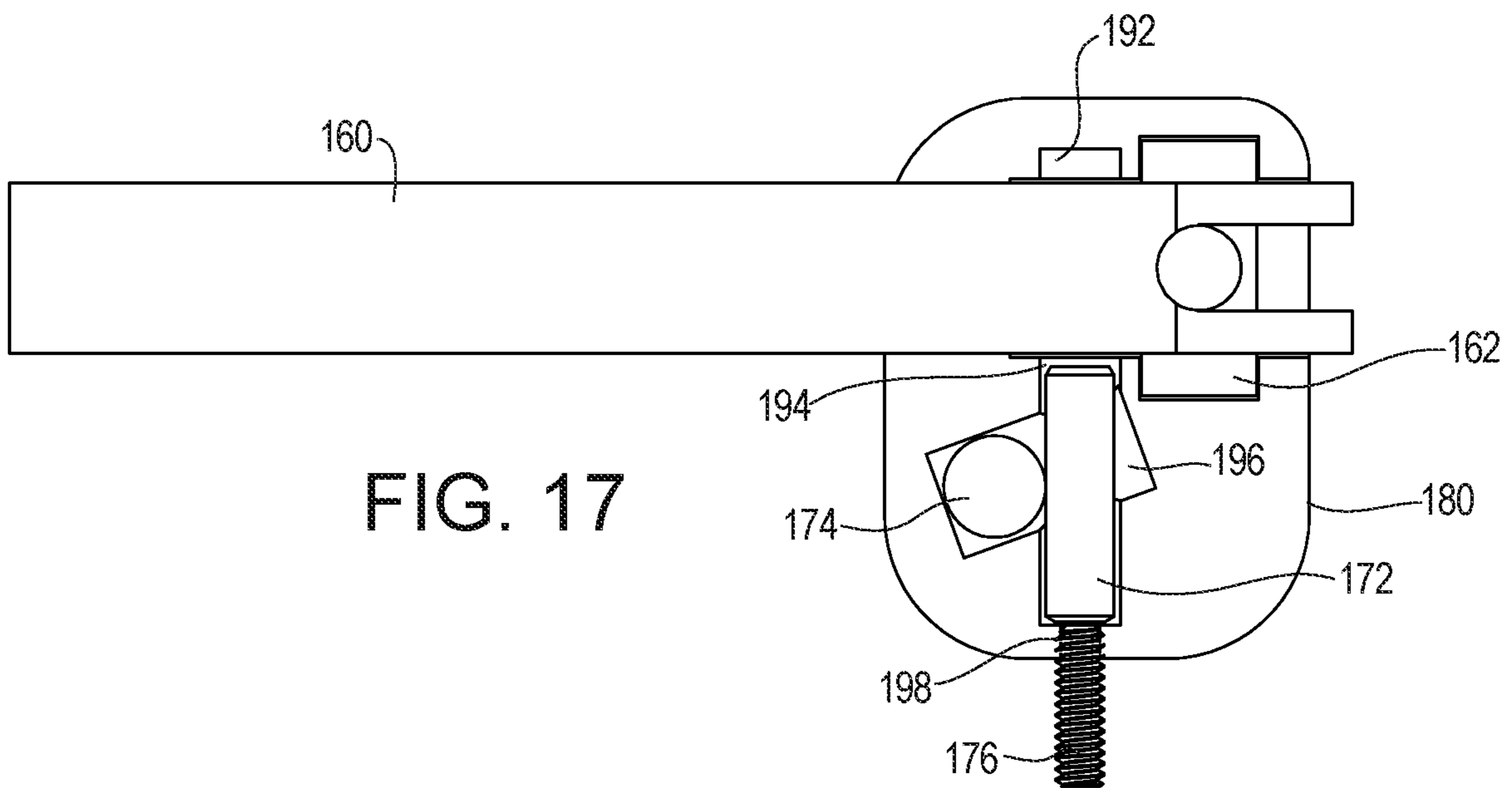
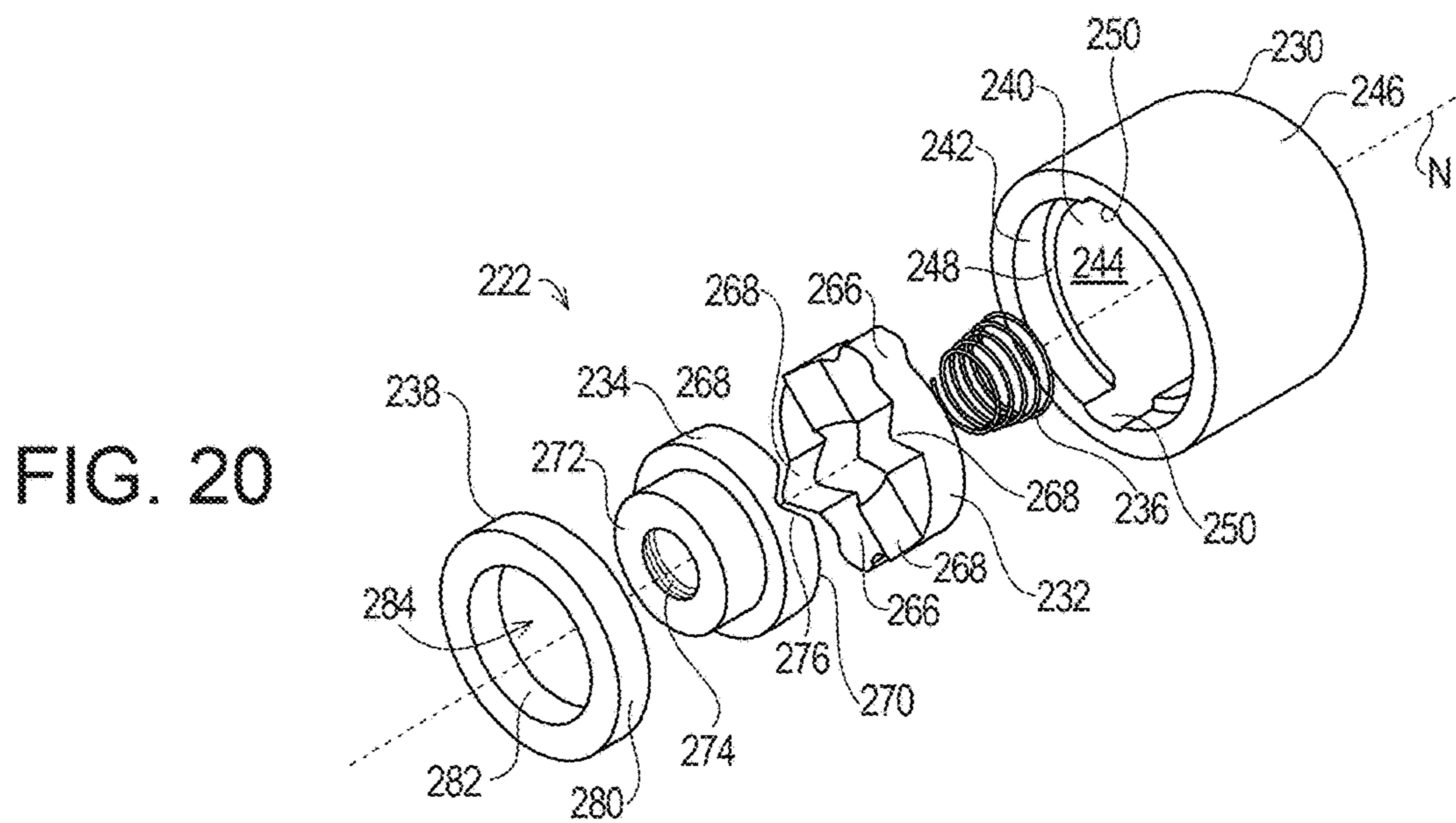
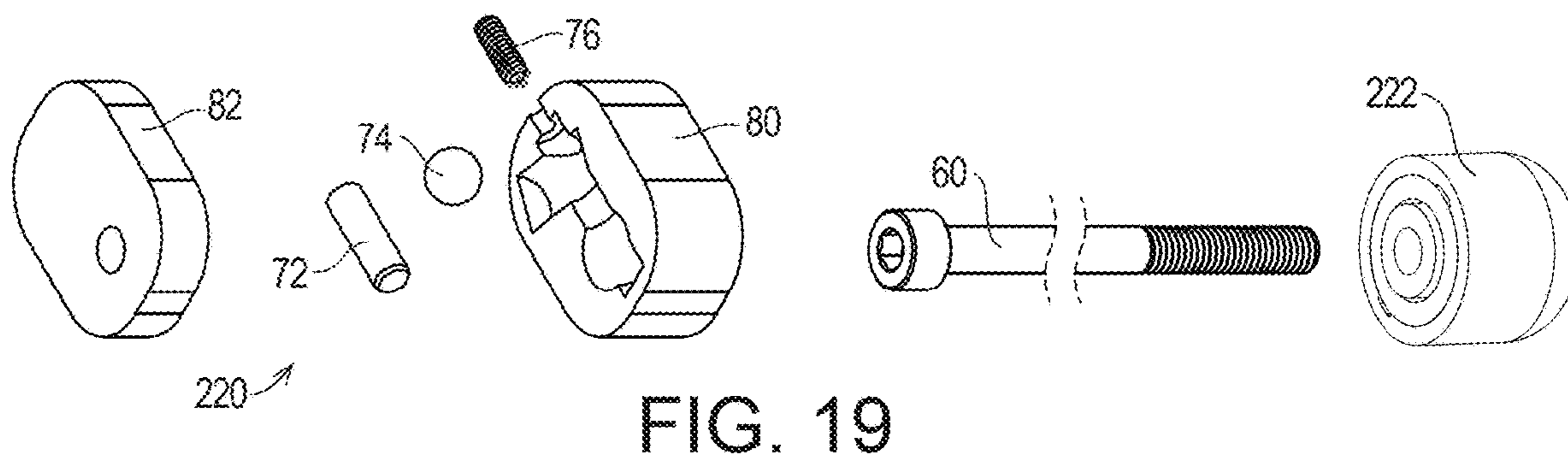
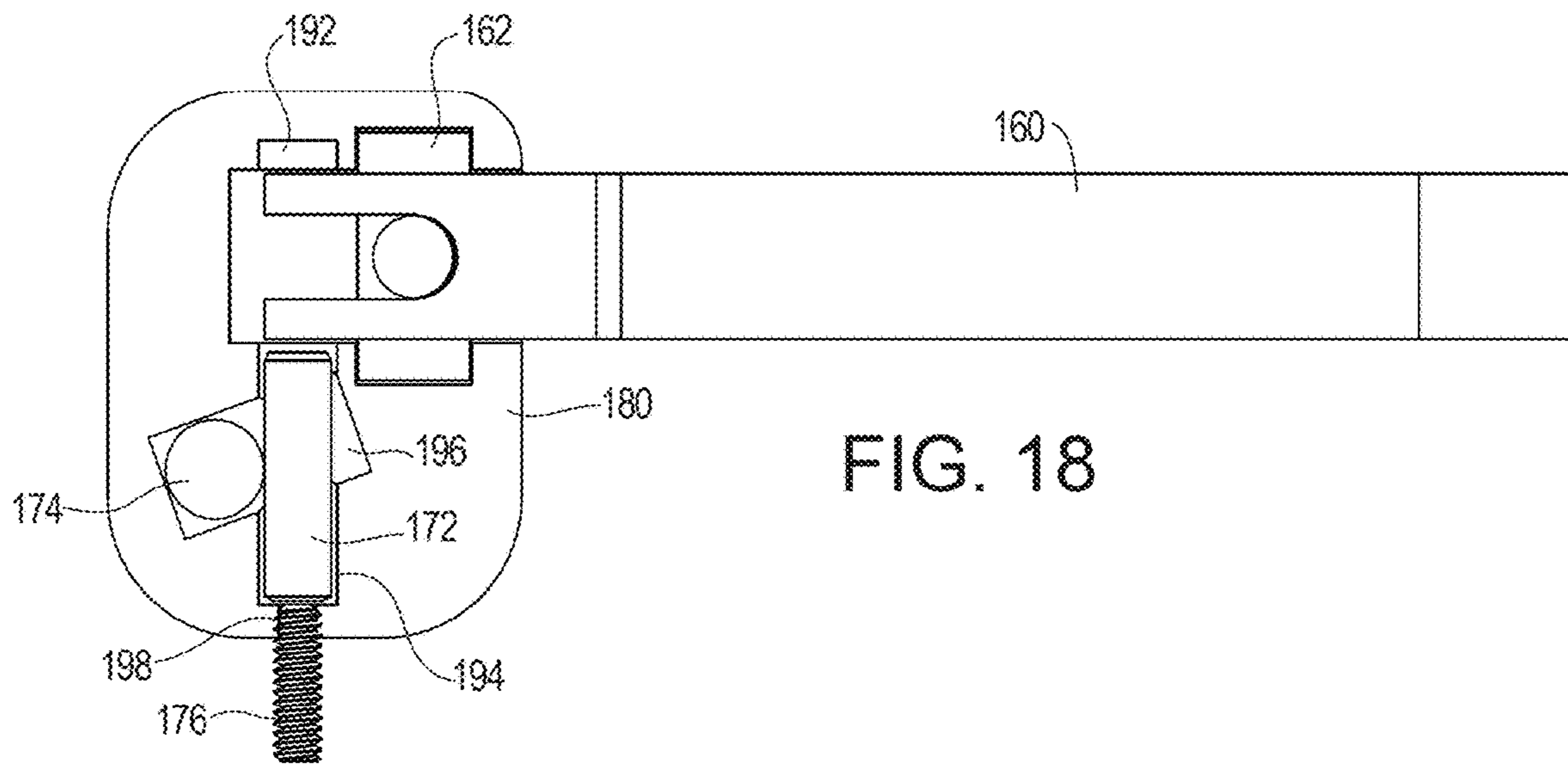


FIG. 17



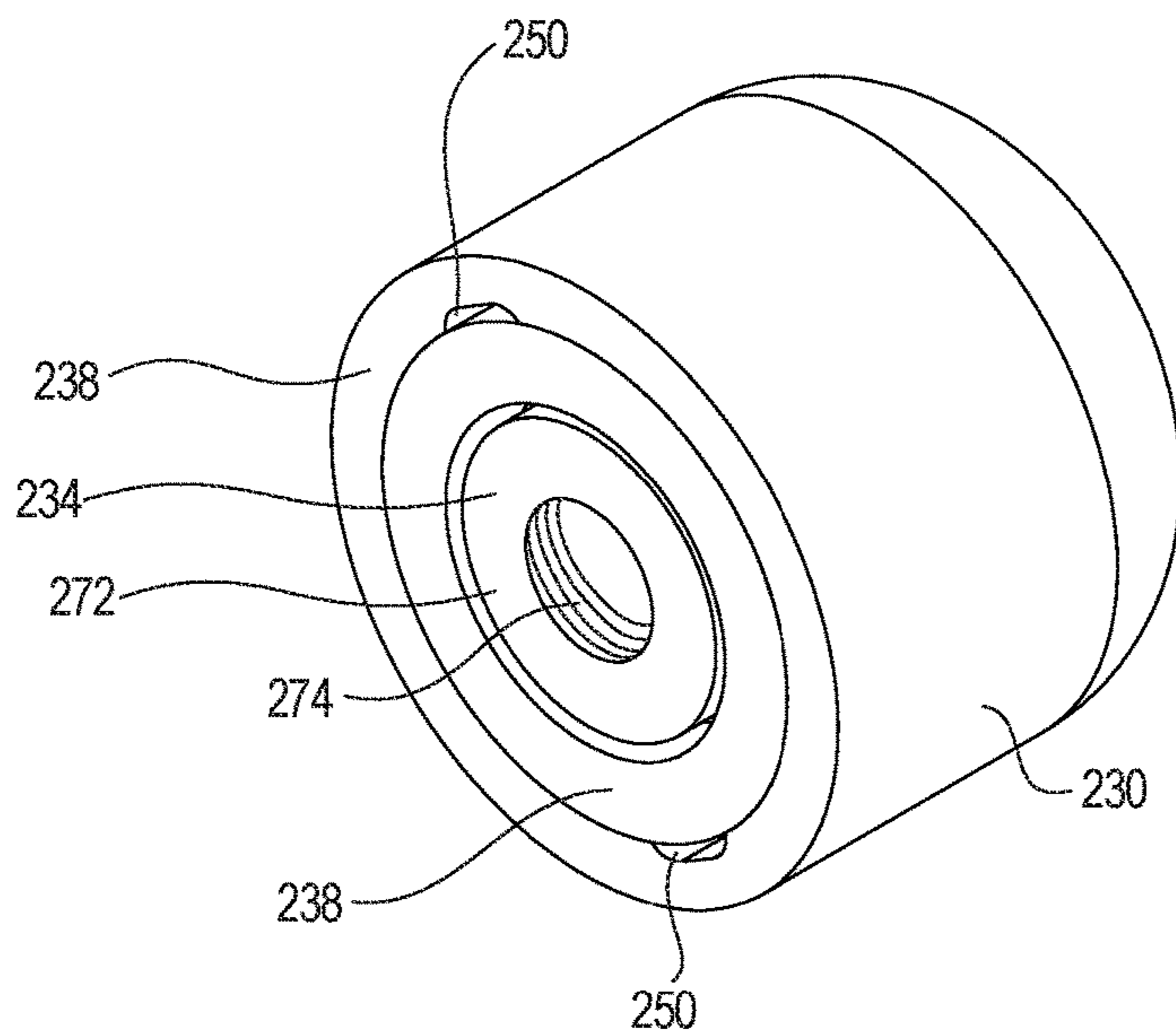


FIG. 21

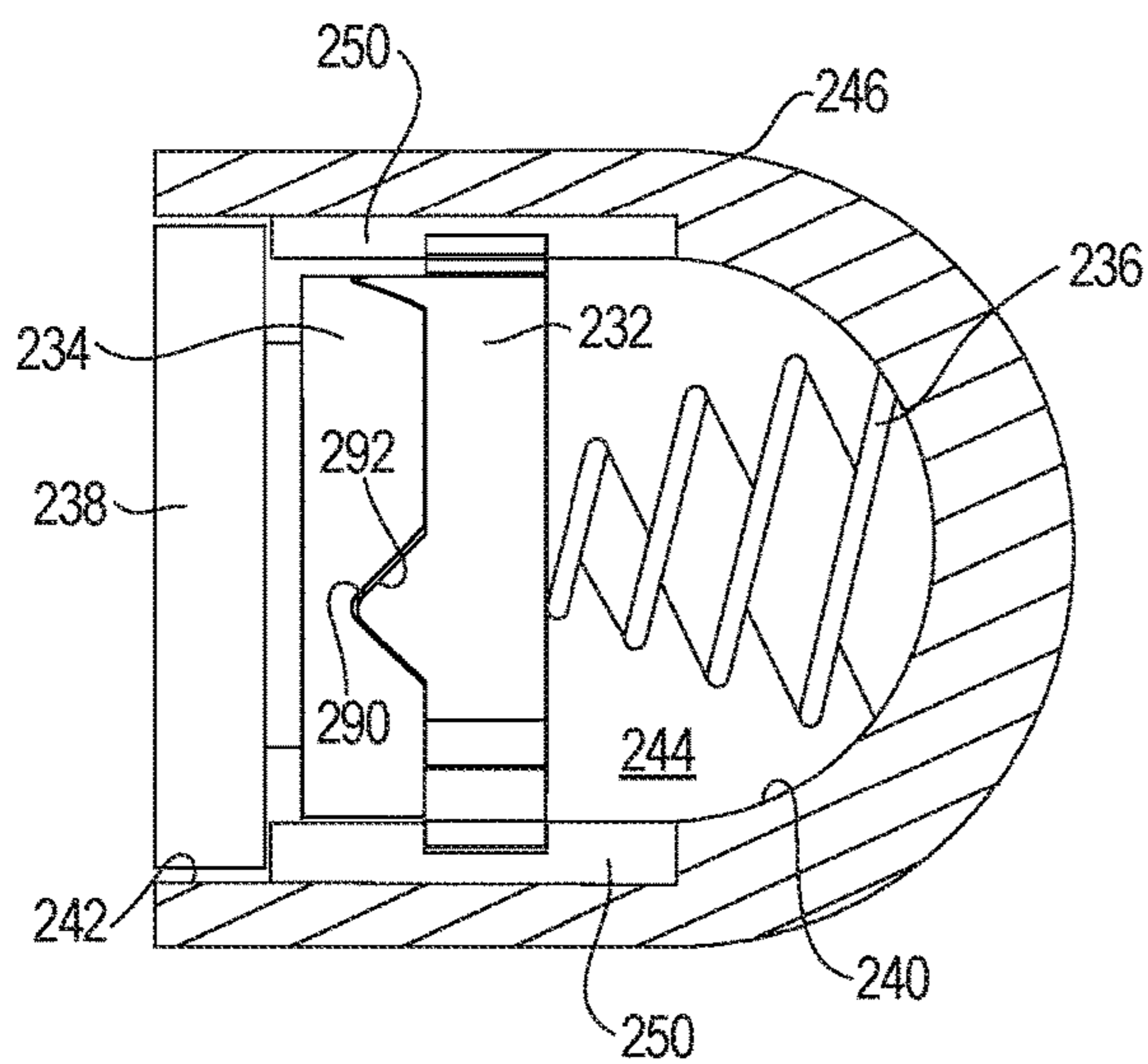


FIG. 22

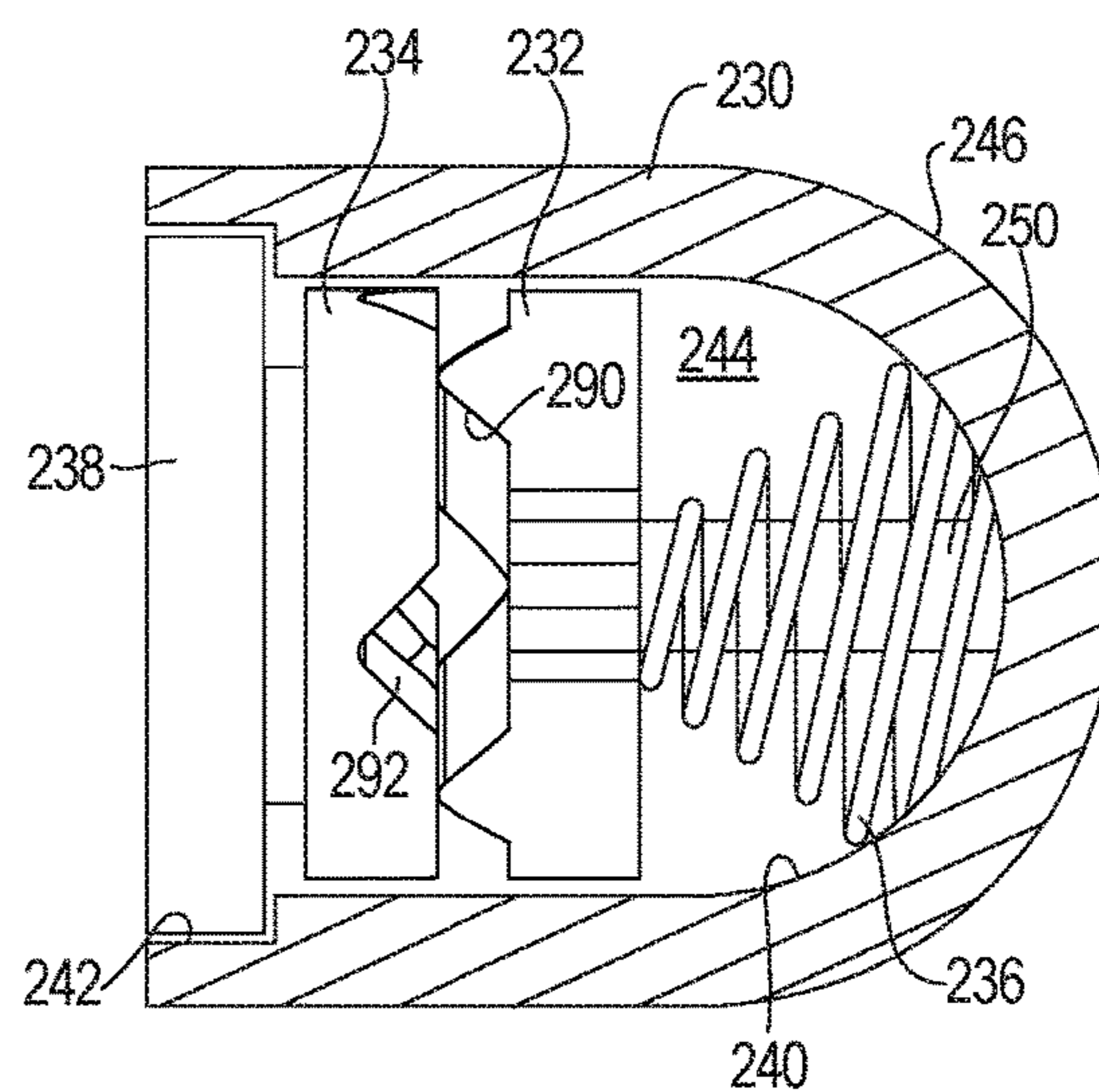
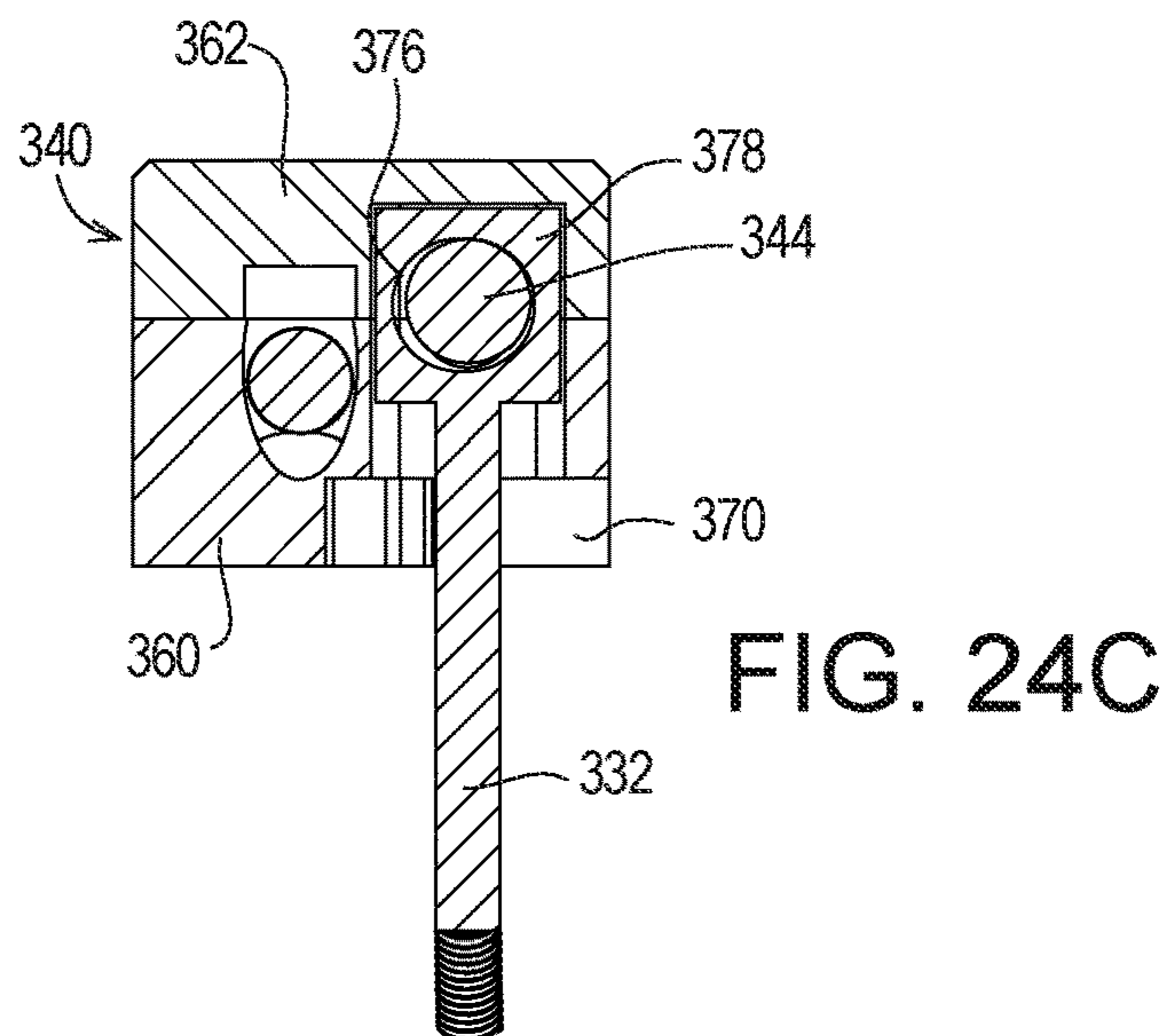
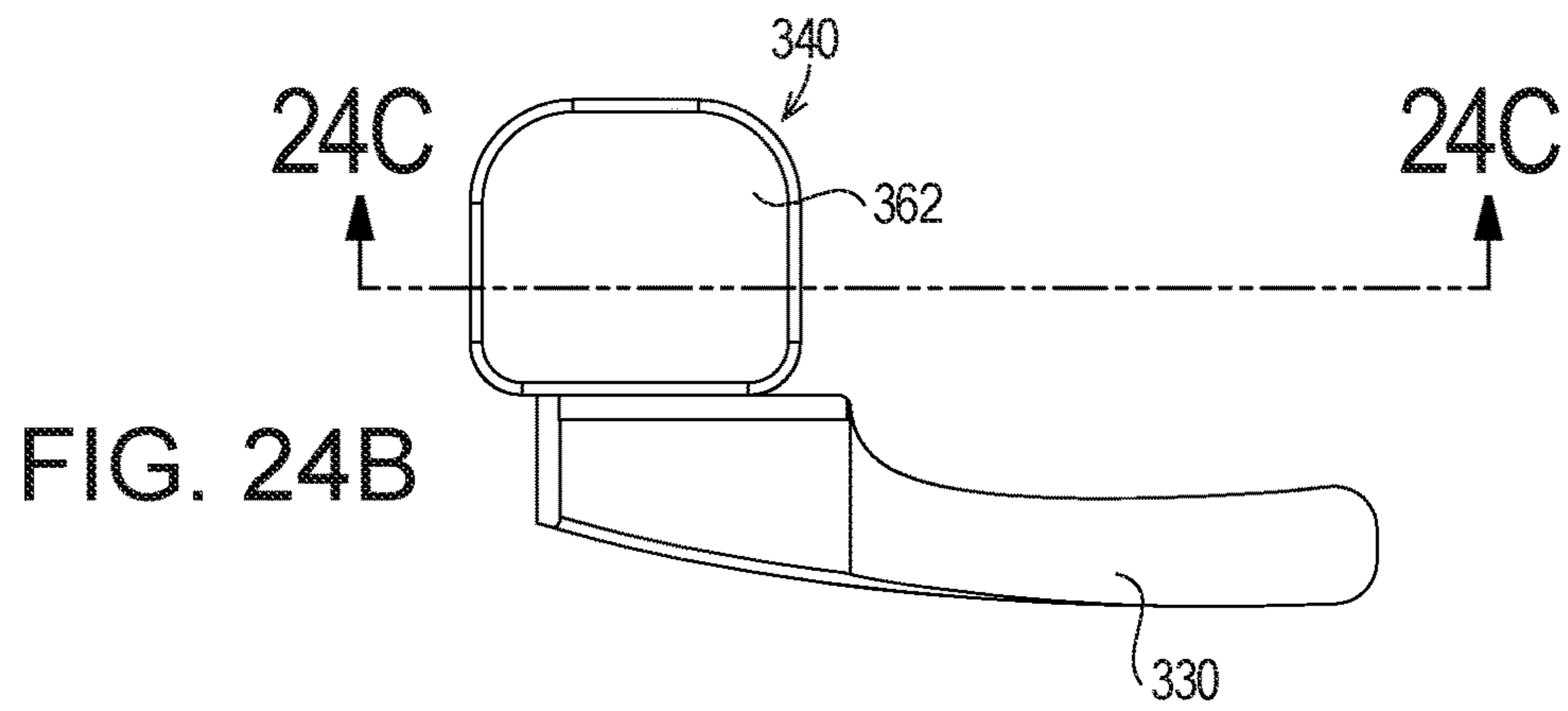
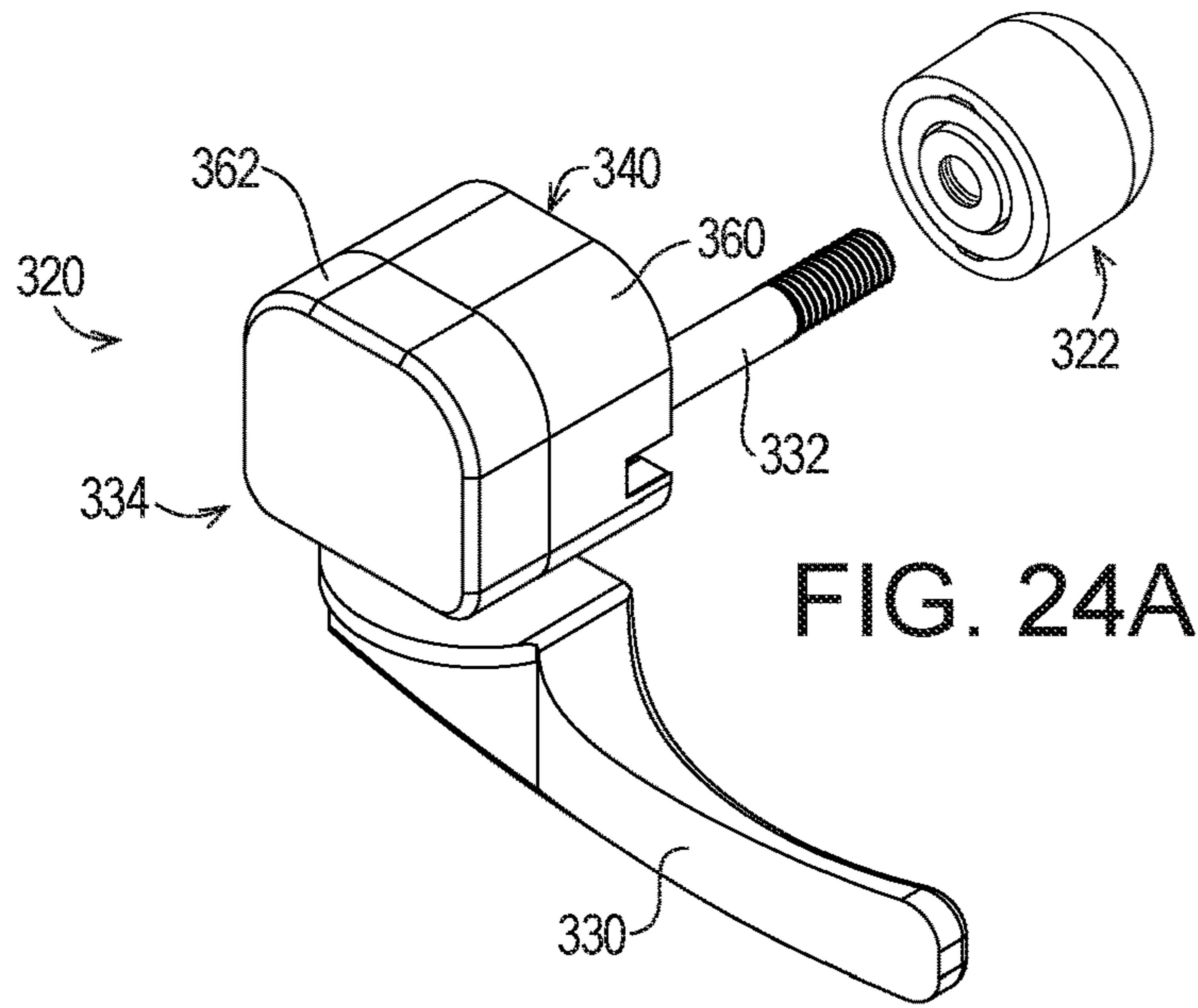
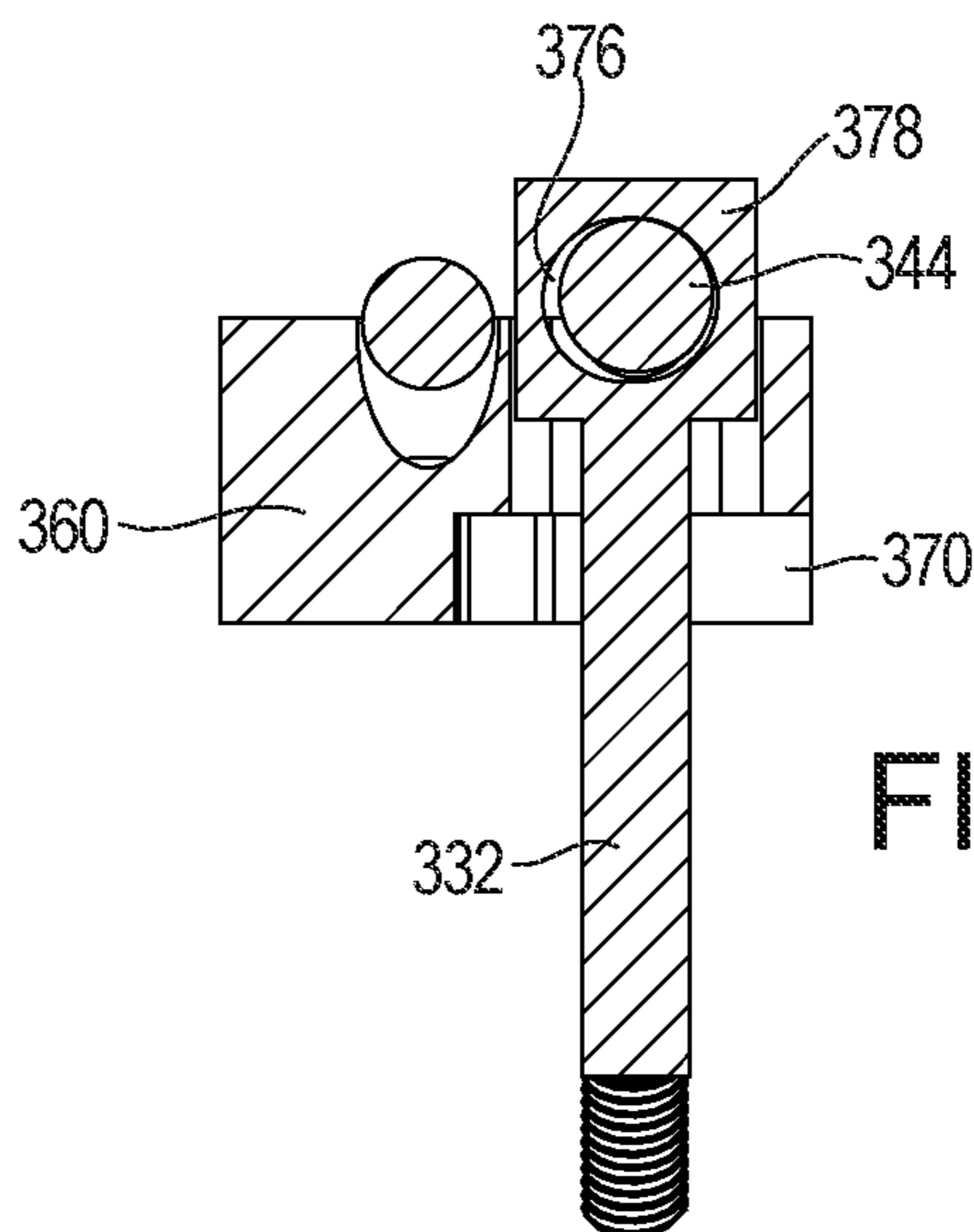
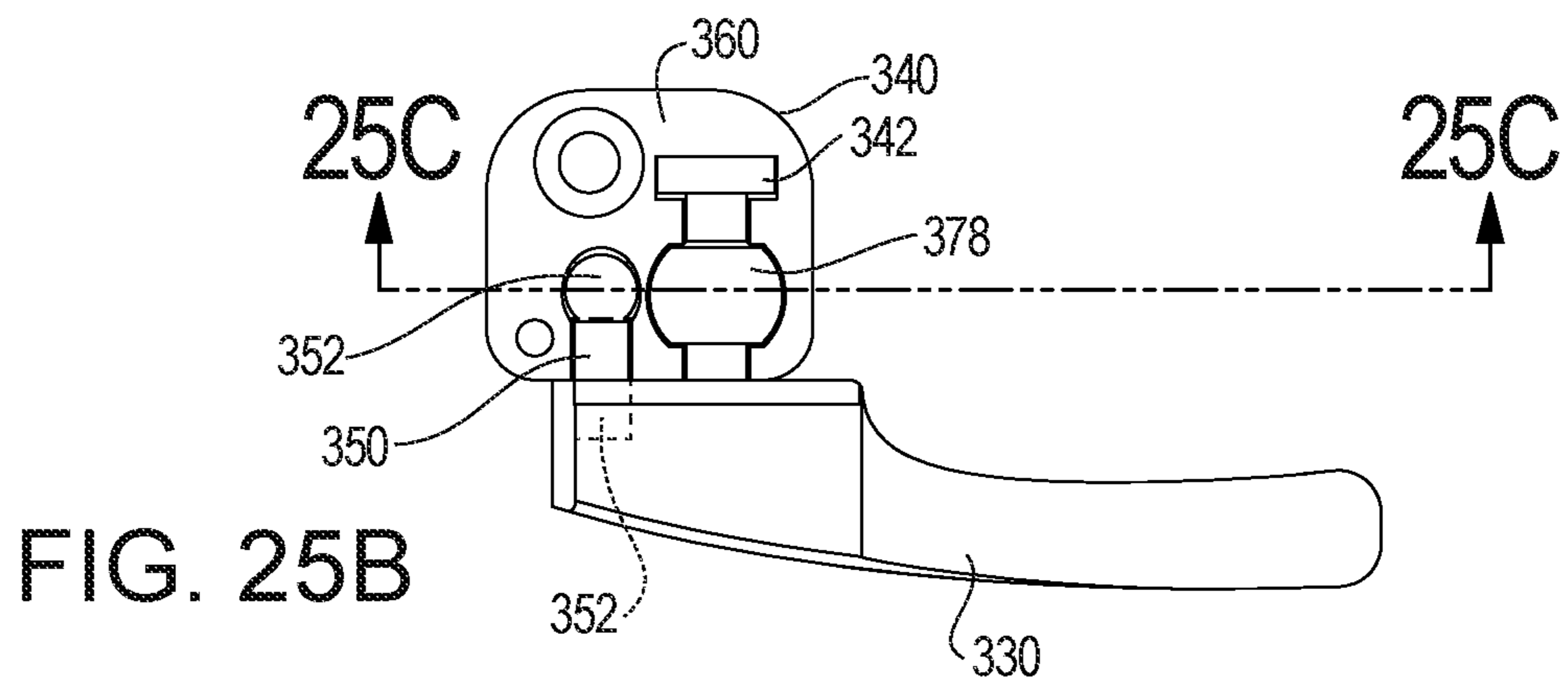
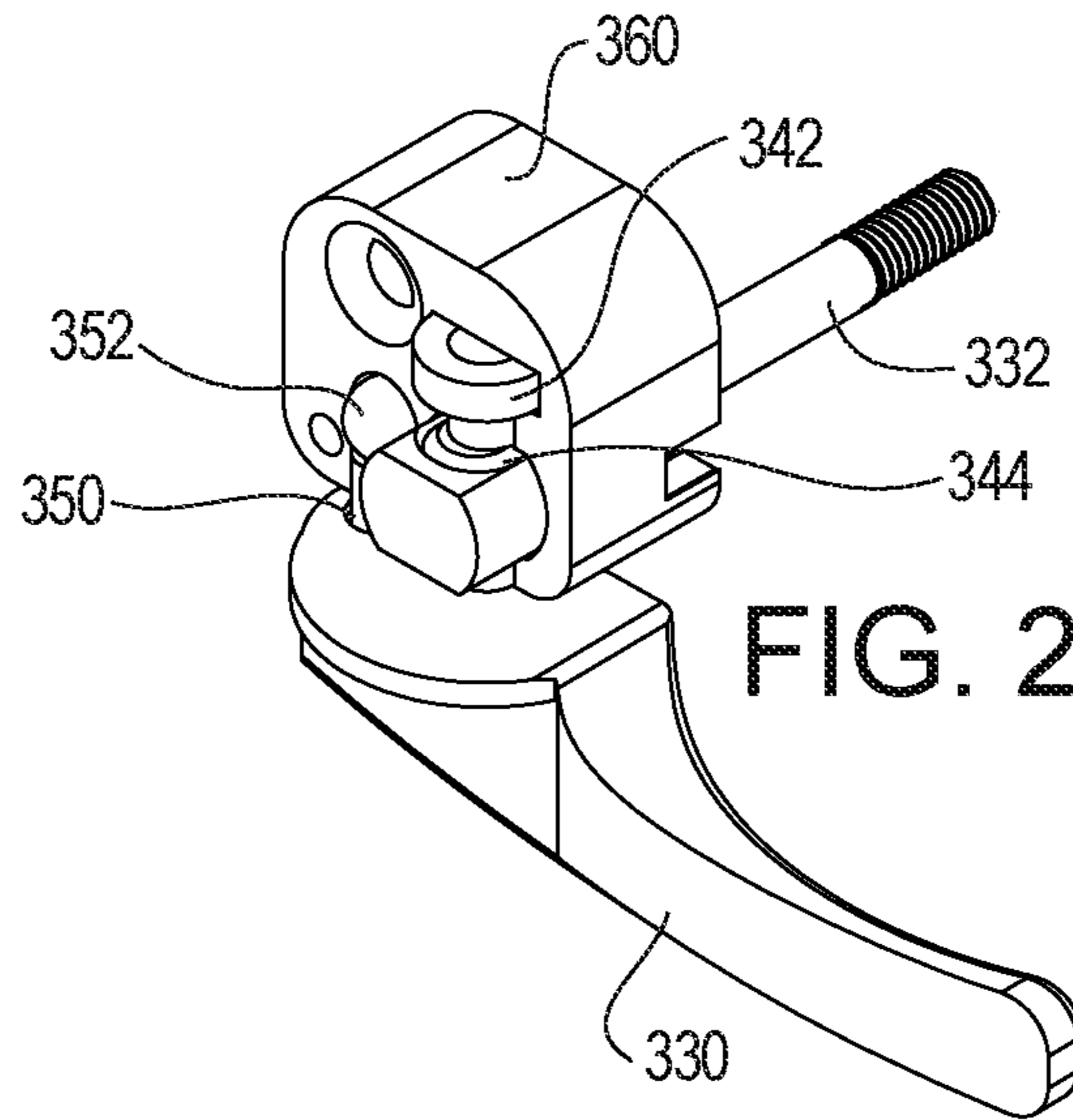
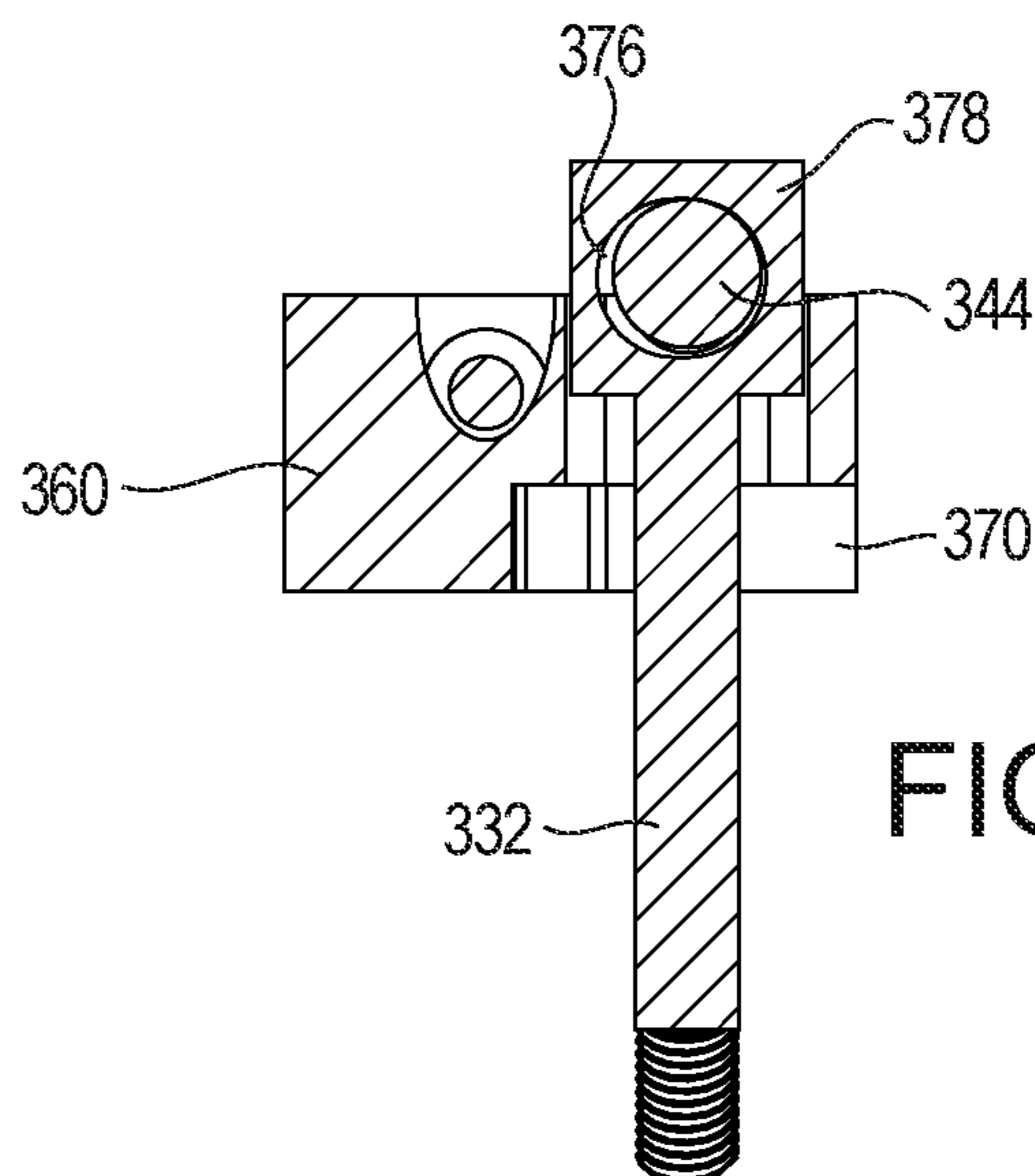
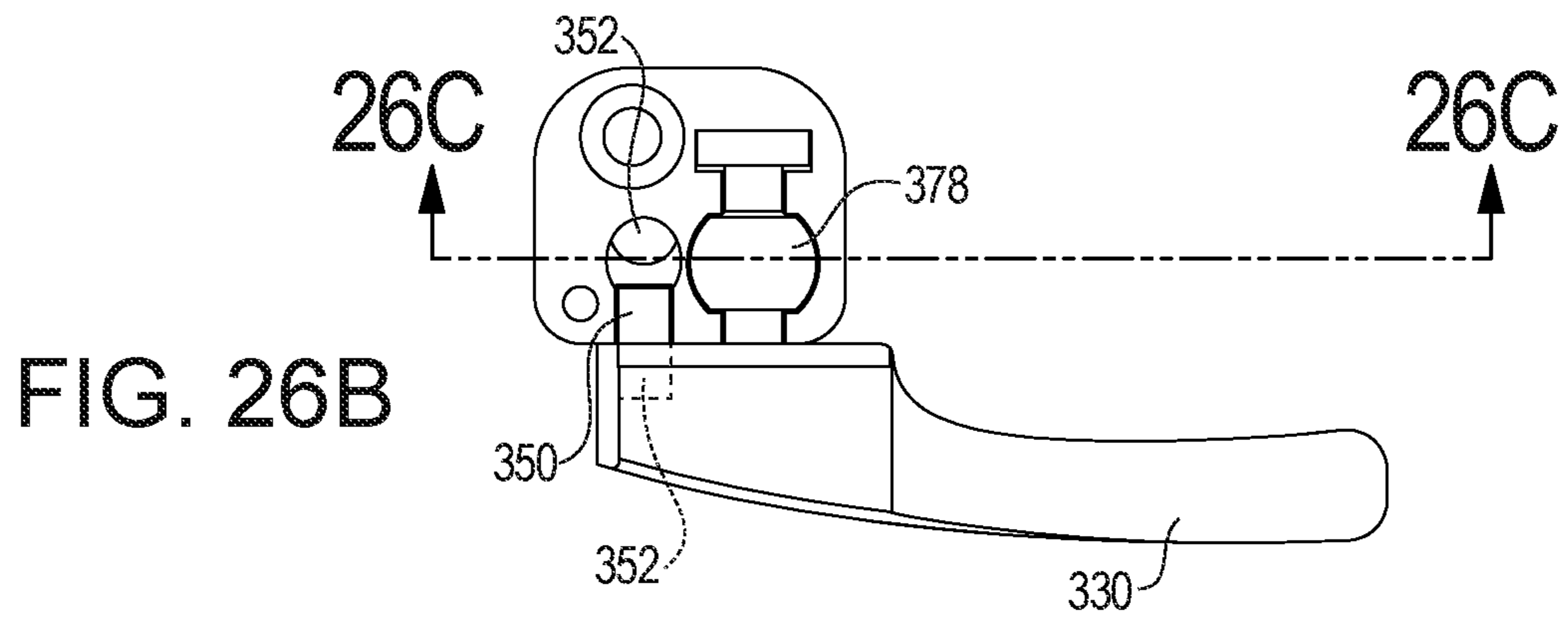
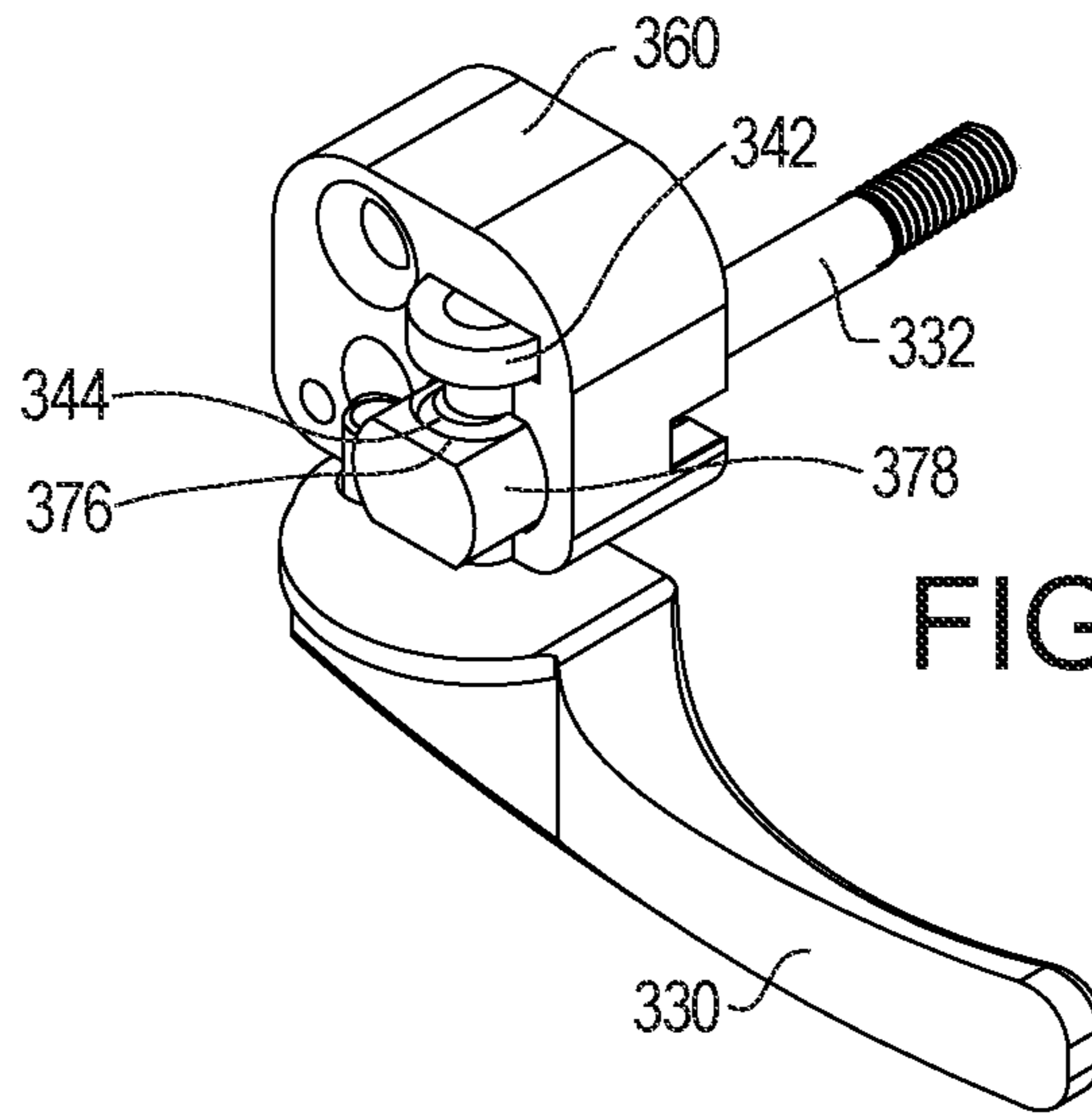


FIG. 23







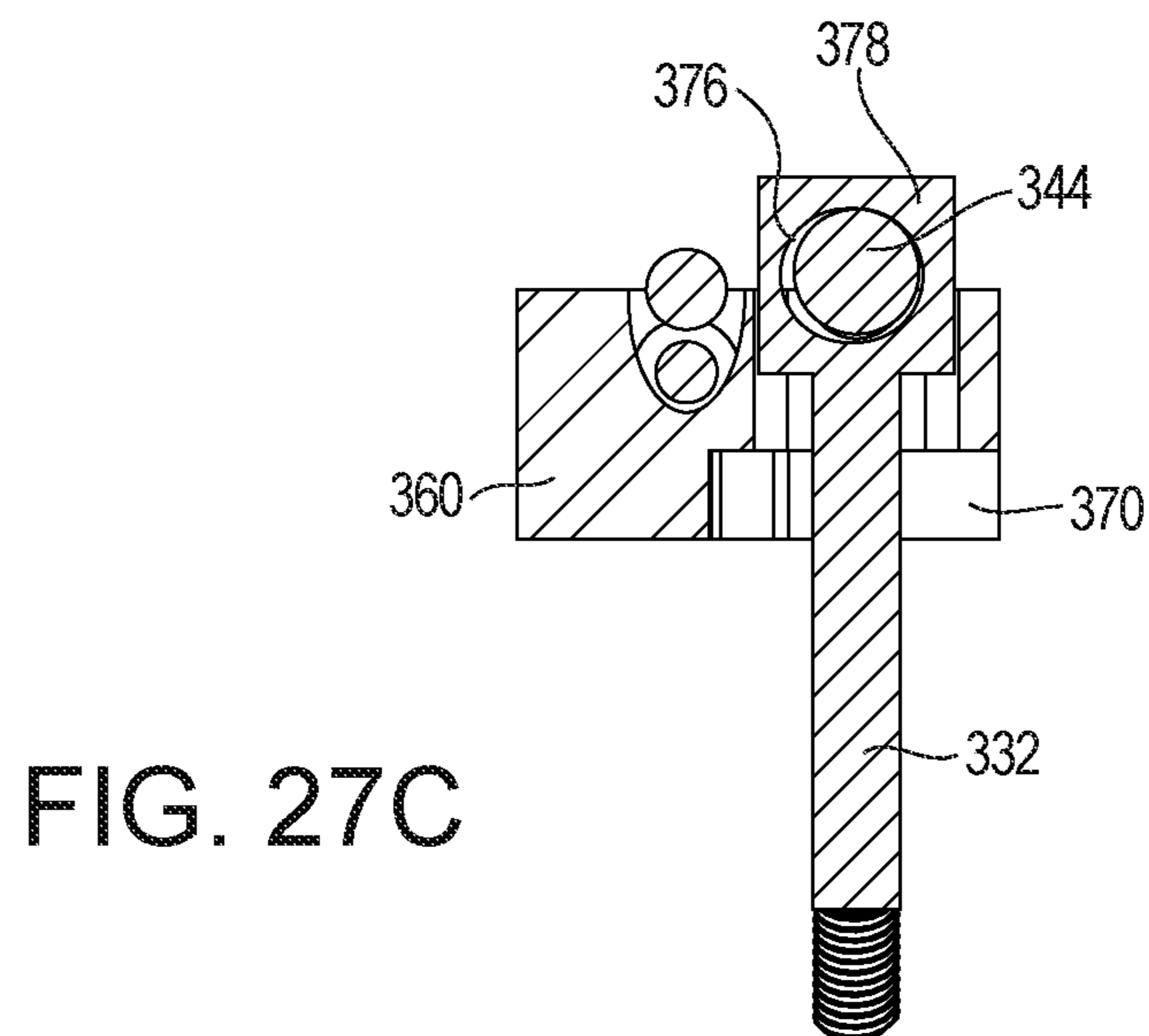
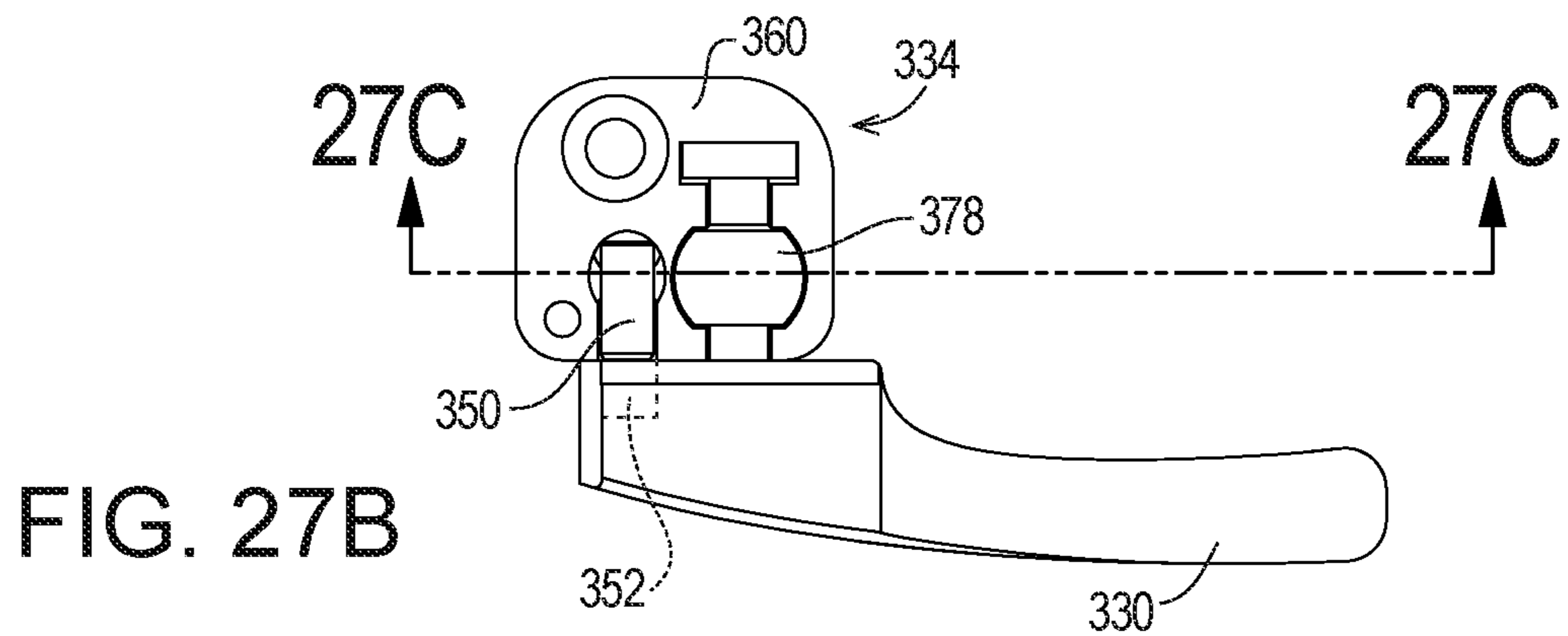
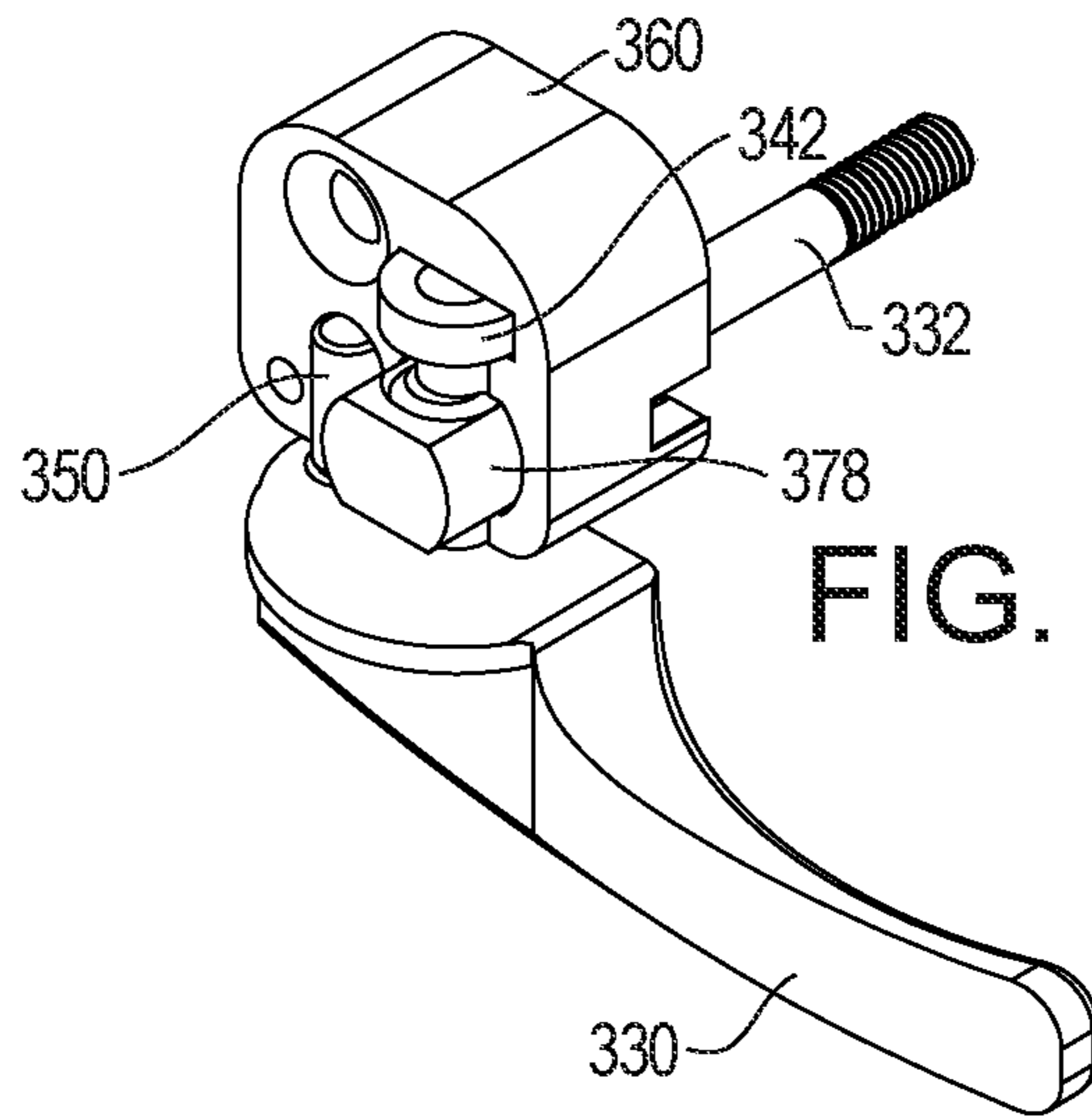


FIG. 28A

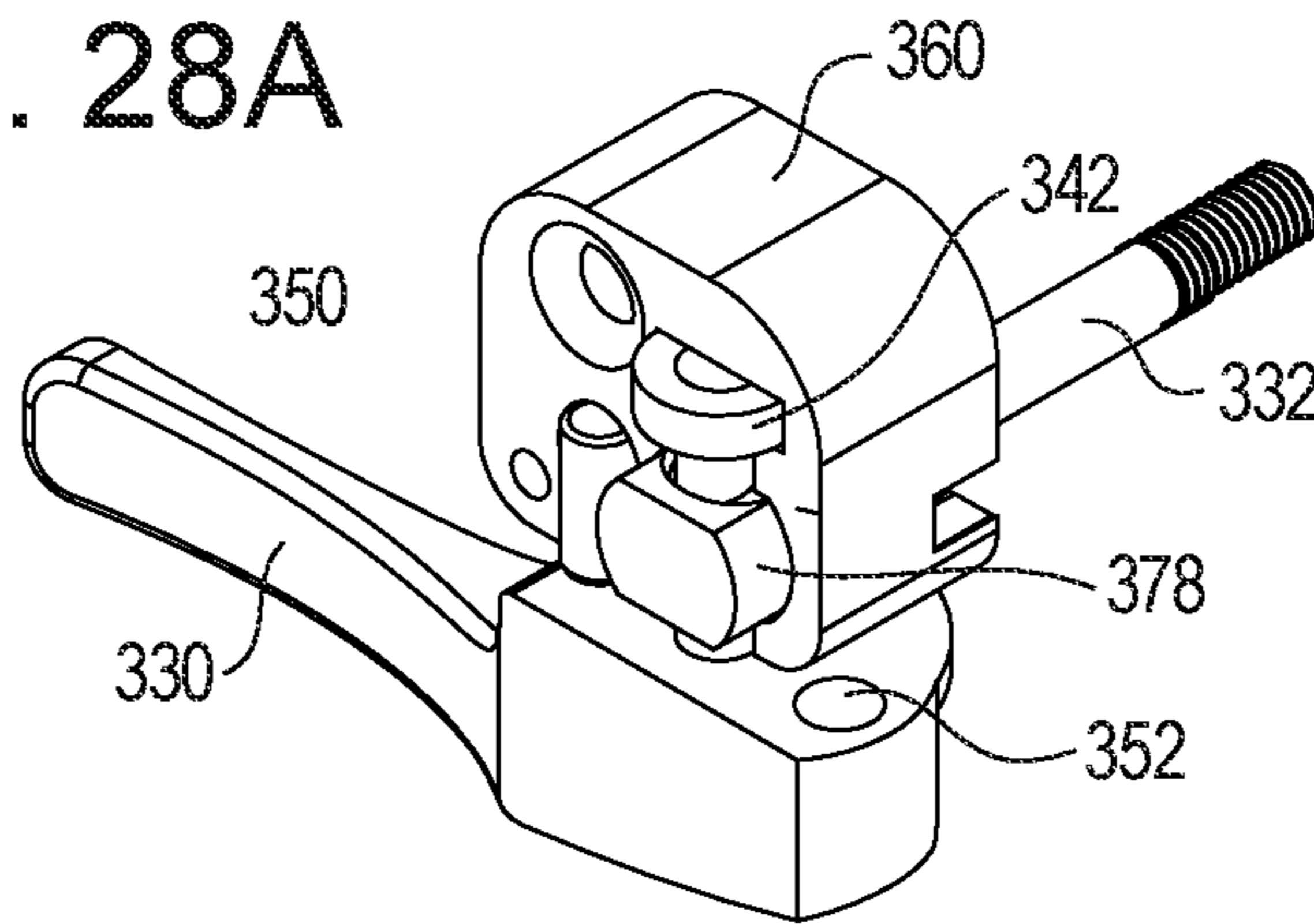


FIG. 28B

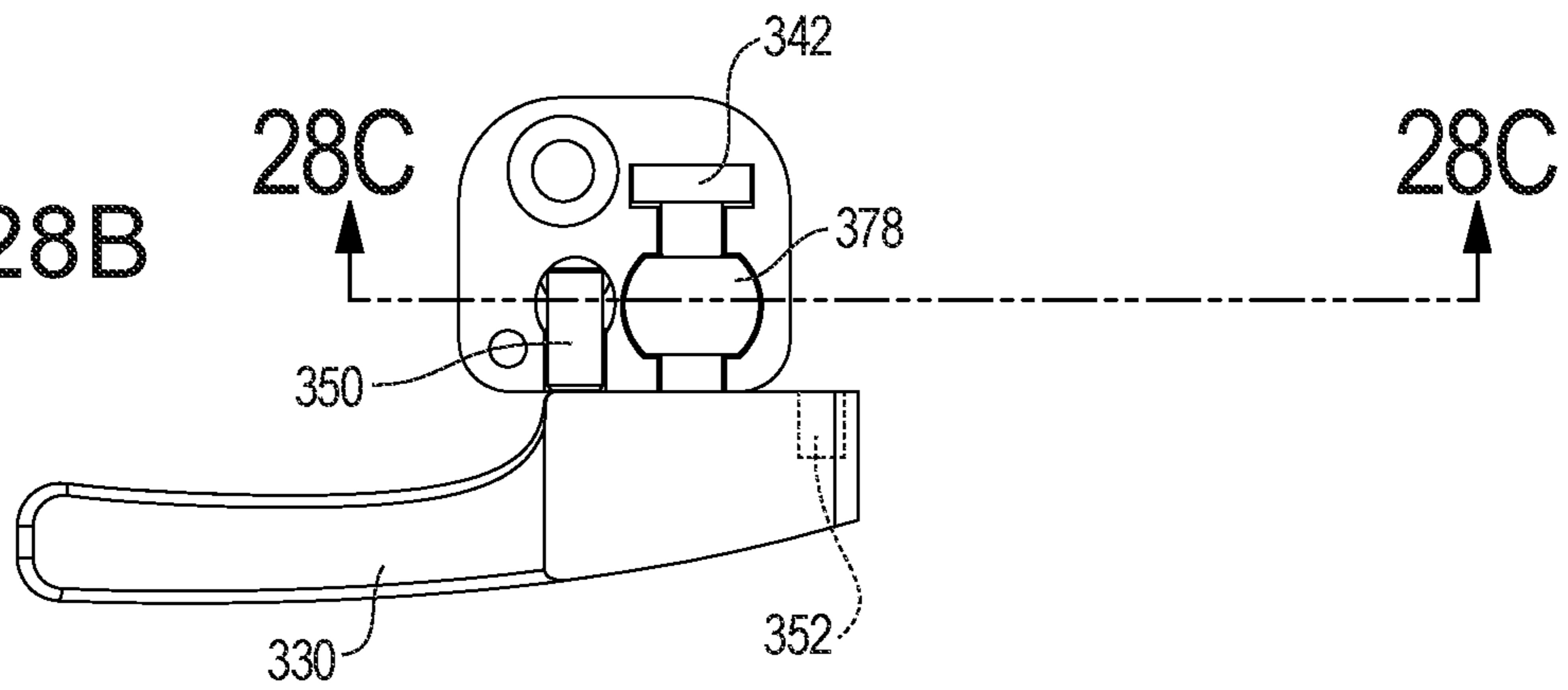
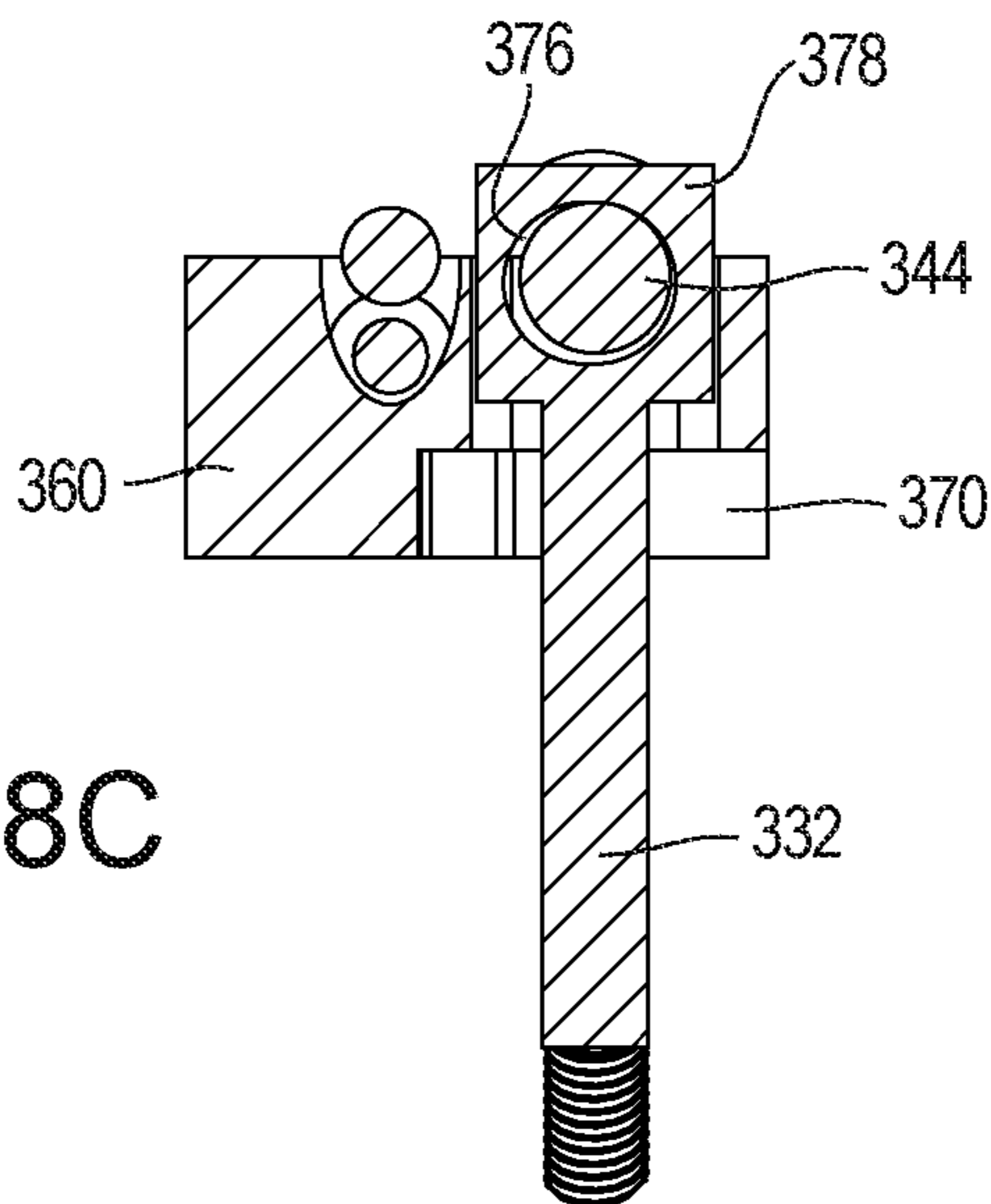


FIG. 28C



THEFT DETERRENT SKEWER SYSTEMS AND METHODS FOR BICYCLES

RELATED APPLICATIONS

The present application U.S. patent application Ser. No. 15/368,597 filed Dec. 3, 2016 claims priority of U.S. Provisional Patent Application Ser. No. 62/262,664, filed Dec. 3, 2015, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to skewer systems and methods for bicycles and, in particular, to skewer systems and methods that deter theft of components of the bicycle.

BACKGROUND

Bicycles typically have a frame, a seat supported by the frame, a fork, a front wheel supported by the fork, and a rear wheel supported by dropouts formed in the frame. Each wheel of a modern bicycle typically comprises a hub, a rim, one or more spokes extending from the hub to the rim, and a tire supported by the rim. An inflated inner tube is typically arranged between the rim and tire such that the tire is resiliently spaced from the rim. A skewer assembly is typically used to secure the front wheel to the fork and the rear wheel to the frame. The seat of a modern bicycle system comprises a saddle and a seat post. The frame defines a seat tube that receives the seat post. A skewer assembly may be used to tighten a clamp assembly on the seat tube to secure the seat post such that the saddle is at a desired position relative to the frame.

For a variety of reasons, one or more components of a bicycle may require modification or replacement. For example, the inner tube may become damaged during normal operation of the bicycle. When the inner tube is damaged, it must be removed for repair or replacement. As another example, the rider may adjust the height of the bicycle seat at a first position when riding uphill and a second position when riding downhill.

To facilitate removal, repair, adjustment, and/or replacement of bicycle components, modern bicycle components are typically removably supported from the bicycle fork and/or frame by one or more skewer assemblies. One type of skewer assembly, referred to herein as a simple bolt skewer assembly, comprises a bolt and nut. A simple bolt skewer assembly may be arranged between the fork and/or dropouts to support the hub of the wheel. A simple bolt skewer assembly may also be arranged to tighten the seat tube clamp. A simple bolt skewer assembly requires a tool to loosen the bolt assembly. Conventionally, a hex key or other conventional tool may be used to loosen the bolt assembly of a simple bolt type skewer assembly. Another type of skewer assembly, referred to herein as a quick release skewer assembly, comprises a lever to facilitate tightening and loosening of the bolt assembly. A quick release skewer assembly allows removal of a bicycle component simply by operating the lever and without the use of a tool. In particular, the lever defines a cam surface that tightens the bolt and nut as the lever is rotated into a closed position relative to the bolt.

Both simple bolt and quick release skewer assemblies simplify removal of the bicycle component to the extent that theft of bicycle components is a substantial problem. In particular, typical bicycle locks are configured to secure the

frame to a fixed structure such as a bike rack or the like. Often, however, components such as the wheels and/or seat are not secured to the fixed structure by the lock, and the wheels and/or seat may easily be stolen while leaving the bicycle frame in place.

One approach to inhibiting theft of bicycle wheels using a simple bolt type skewer assembly is to modify the bolt such that a special tool is required to loosen the bolt assembly. Instead of a conventional hex key or wrench, a keyed tool is required to rotate the nut. Without the appropriate keyed tool, rotation of the bolt assembly is sufficiently difficult to deter theft under many situations. However, the keyed tool must be available for use any time the bicycle component must be removed or adjusted. If the keyed tool is misplaced or forgotten, replacement or adjustment of the bicycle component may be difficult if not impossible until a new tool is obtained from the manufacturer.

Another approach to inhibiting theft of bicycles is to modify the nut portion of the skewer assembly. As an example, the nut may be provided with a rounded or conical surface that inhibits securing of the nut to a tool for rotating the nut. Such modified nuts prevent the rotation of the nut relative to the bolt under most conditions and but do not prevent rotation of the bolt.

The need exists for improved systems and methods for locking bicycle components relative to the frame and/or fork of the bicycle.

SUMMARY

The present invention may be embodied as a skewer assembly for securing a component to a first portion of a bicycle comprising a bolt, a housing, and a first lock member. The bolt detachably attaches the component to the first portion of the bicycle. The housing is supported relative to the bolt. The first lock member supported by the housing such that: when the skewer assembly is in an upright orientation, the first lock member inhibits tightening of the bolt; and when the skewer assembly is at least partly displaced from the upright orientation, the first lock member is displaced to allow tightening of the bolt.

The present invention may also be embodied as a method of securing a component to a portion of a bicycle comprising the following steps. A bolt for detachably attaching the component to the first portion of the bicycle is provided. A housing is supported relative to the bolt. A first lock member is supported with the housing. The skewer assembly is arranged in an upright orientation such that the first lock member inhibits tightening of the bolt. The skewer assembly is at least partly displaced from the upright orientation such that the first lock member is displaced, thereby allowing tightening of the bolt.

The present invention may be embodied as a bicycle assembly comprising a frame, a fork, a front wheel, a rear wheel, and first, second, and third bolts. The first bolt detachably attaches the front wheel to the fork. The second bolt detachably attaches the rear wheel to the frame. The third bolt detachably attaches the seat to the frame. At least one housing is supported relative to at least one of the first bolt, the second bolt, and the third bolt. A first lock member is supported by the at least one housing such that: when the bicycle assembly is in an upright orientation, the first lock member inhibits tightening of the bolt; and when the bicycle assembly is at least partly displaced from the upright orientation, the first lock member is displaced to allow tightening of the bolt.

DESCRIPTION OF DRAWING

FIG. 1 is a side elevation view of an example bicycle employing a first example lock system of the present invention;

FIG. 2 is a detail of a portion of the bicycle depicted in FIG. 1;

FIG. 3 is an exploded view of skewer assembly incorporating the first example lock system;

FIGS. 4A and 4B are section views depicting interaction of the first example lock system with the bicycle depicted in FIG. 1;

FIGS. 5-8 are side elevation views with a housing cap removed depicting a method of using the first example lock system;

FIG. 9 is a side elevation view of an example bicycle employing a second example lock system of the present invention;

FIG. 10 is a detail of a portion of the bicycle depicted in FIG. 9;

FIG. 11 is an exploded view of portion of skewer assembly incorporating the second example lock system;

FIG. 12 is a front elevation view of the axle assembly incorporating the second example lock system;

FIG. 13 is a section view taken along lines 13-13 in FIG. 12;

FIGS. 14-18 are side elevation views with a housing cap removed depicting a method of using the second example lock system;

FIG. 19 is an exploded view of a third example skewer assembly using the first example lock system and an example slip nut assembly;

FIG. 20 is an exploded view of the example slip nut assembly;

FIG. 21 is a perspective view of the example slip nut assembly;

FIG. 22 is a partial section view of the example slip nut assembly in a drive configuration in which the slip nut assembly may be tightened onto an axle bolt of the third example skewer assembly;

FIG. 23 is a partial section view of the example slip nut assembly in a slip configuration in which the slip nut assembly may not be further tightened onto or removed from the axle bolt of the third example skewer assembly;

FIG. 24A is an exploded perspective view of a fourth example skewer assembly using a third example lock system;

FIG. 24B is front elevation view of the fourth example skewer assembly;

FIG. 24C is a section view taken along lines 24C and 24C in FIG. 24B;

FIG. 25A is a perspective view of the third example lock system with a housing cap thereof removed to illustrate the primary and tertiary lock members thereof in a first configuration when the fourth example skewer system is upright and the lever is in a closed position;

FIG. 25B is front elevation view similar to FIG. 25A;

FIG. 25C is a section view taken along lines 25C and 25C in FIG. 25B;

FIG. 26A is a perspective view of the third example lock system with a housing cap thereof removed to illustrate the primary and tertiary lock members thereof in a second configuration when the fourth example skewer system begins to be inverted and the lever is in the closed position;

FIG. 26B is front elevation view similar to FIG. 26A;

FIG. 26C is a section view taken along lines 26C and 26C in FIG. 26B;

FIG. 27A is a perspective view of the third example lock system with a housing cap thereof removed to illustrate the primary and tertiary lock members thereof in a third configuration when the fourth example skewer system is fully inverted and the lever is in the closed position;

FIG. 27B is front elevation view similar to FIG. 27A;

FIG. 27C is a section view taken along lines 27C and 27C in FIG. 27B;

FIG. 28A is a perspective view of the third example lock system with a housing cap thereof removed to illustrate the primary and tertiary lock members thereof in a fourth configuration when the fourth example skewer system is fully inverted and the lever is in the open position;

FIG. 28B is front elevation view similar to FIG. 28A; and

FIG. 28C is a section view taken along lines 28C and 28C in FIG. 28B.

DETAILED DESCRIPTION OF EXAMPLES OF THE INVENTION

The principles of the present invention may be embodied in different forms and using different combinations of components. Several examples of skewer assemblies constructed in accordance with, and embodying, the principles of the present invention will be described below.

I. First Example Skewer Assembly

FIG. 1 illustrates a bicycle 20 comprising a frame assembly 22, a front wheel assembly 24, and a rear wheel assembly 26. As is conventional, the frame assembly 22 comprises a main frame 30 and a fork 32 and the fork comprises at least one blade 34. FIGS. 4A and 4B illustrate that each blade 34 defines a drop out 36 defining an axle notch 38. A similar drop out and axle notch are formed in the main frame 30 for the rear wheel assembly 26 but are not visible in the drawing. The example wheel assemblies 24 and 26 each comprise a hub 40, spokes 42, a rim 44, and a tire 46. The spokes 42 extend between the hub 40 and rim 44, and the rim 44 supports the tire 46. The frame assembly 22 and wheel assemblies 24 and 26 are or may be conventional and will not be described in detail beyond what is helpful for a complete understanding of the present invention.

FIG. 1 further illustrates that a front skewer assembly 50 connects the front wheel assembly 24 to the fork 32, that a rear skewer assembly 52 connects the rear wheel assembly 26 to the main frame 30, and that a seat skewer assembly 54 engages a clamp structure 56 for clamping a seat post 58 relative to the main frame 30. The front, rear, and seat skewer assemblies may be similar or different. The example front, rear, and seat skewer assemblies 50, 52, and 54 are all the same and embody a first example skewer assembly of the present invention. For brevity, only the front skewer assembly 50 and the engagement of the skewer assembly 50 with the fork 32 will be described herein in detail. One of ordinary skill in the art will understand that the rear skewer assembly 52 will engage the drop out in the main frame 30 and that the seat skewer assembly 54 will compress portions of the clamp structure 56 in a manner similar to the manner in which the front skewer assembly 52 engages the fork 32.

FIG. 3 illustrates that the example front skewer assembly 50 comprises an axle bolt 60, an axle nut 62, and a lock assembly 64. The axle bolt 60 defines a head portion 66 in which is formed a hex cavity 68. The example seat skewer assembly 54 will include a clamp bolt instead of the axle bolt

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60, and the clamp bolt will typically be sized and dimensioned for the particular clamp structure 56 defined by the example bicycle 20.

FIG. 3 further illustrates that the example lock assembly 64 comprises a housing 70 and a primary lock member 72. The example primary lock member 72 is a cylindrical member. Optionally, the example lock assembly 64 may also be provided with one or both of a secondary lock member 74 and a tertiary lock member 76. The example secondary lock member 74 is a sphere or ball, and the example tertiary lock member 76 is a set screw. In this example, a diameter of a sphere forming the example secondary lock member 74 is smaller than a diameter of a cylindrical member forming the example primary lock member 72. The example housing 70 comprises a housing base 80 and a housing cap 82. At least one base projection 84a (FIG. 4A) or 84b (FIG. 4B) extends from the housing base 80. An access opening 86 is formed in the housing cap 82.

When the housing base 80 and housing lid 82 are secured together, the example housing 70 defines a through hole 90, a head cavity 92, a primary cavity 94, a secondary cavity 96, and a threaded hole 98. The example through hole 90 and head cavity 92 are cylindrical and coaxially aligned. The example primary cavity 94 is cylindrical and defines a primary axis A that intersects the head cavity 92 at substantially a right angle to the axis of the head cavity 92. A diameter of the example primary cavity 94 is slightly larger than the diameter of the primary lock member 72. The secondary cavity 96 defines a secondary axis B that is coplanar with and intersects the primary axis A at an intersection angle and at a location spaced from the head cavity 93. The diameter of the example secondary cavity 96 is slightly larger than a diameter of the example secondary lock member 74. The diameter of the example secondary lock member 74 is, however, larger than a diameter of the primary cavity 94 so that the secondary lock member 74 may not move within the primary cavity 94 along the primary axis A. The threaded hole 98 is also aligned with the primary axis A.

In use, the axle bolt 60 is arranged to extend through the through hole 90 with the head portion 66 within the head cavity 92. The example primary lock member 72 is arranged for sliding movement within the primary cavity 94. When held in a primary locked position (e.g., by gravity) as shown in FIG. 5, the primary lock member 72 covers at least a portion of the hex cavity 68 in the head portion 66. With at least a portion of the hex cavity 68 in the head portion 66 covered, a suitable tool may not be inserted into the head cavity 92. Accordingly, when the skewer assembly 50 in general and the lock assembly 64 in particular are upright (e.g., in an upright orientation), access to the head portion 66 and removal of the wheel assembly 24 from the fork 32 is inhibited.

As shown for example in FIGS. 7 and 8, rotating or at least partly inverting the example housing 70 allows the example primary lock member 72 to be moved from the primary locked position (FIG. 7) to a primary unlocked position (FIG. 8). In the primary unlocked position, the primary lock member 72 allows access to the hex cavity 68. In particular, with the primary lock member 72 in the primary unlocked position, a hex wrench may be inserted through the access hole 86 in the housing cap 82 to engage the hex cavity 68. As shown in FIGS. 4A and 4B, the housing projections 84a and 84b extend from the housing base 80 to engage the blade 34 or the adjacent drop out 36 (or, in the case of the rear wheel assembly 26, a portion of the main frame 30 adjacent to the drop out defined thereby)

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to prevent rotation of the housing 70 about the longitudinal axis of the axle. An orientation of the housing 70 is thus predetermined relative to an orientation of the bicycle 20.

Accordingly, only by at least partly inverting the bicycle 20 and thus the housing 70, one or more tools may be used to allow the axle bolt 60 and axle nut 62 to be rotated relative to each other to loosen the front skewer assembly 50 and thus allow removal of the front wheel assembly 24 from the fork 32. If the bicycle 20 cannot be inverted for some reason (e.g., chained to a bike rack), the primary lock member 72 prevents access to the hex cavity 68 and thus inhibits removal of the front wheel assembly 24.

The example secondary lock member 74 is arranged for rolling movement within the secondary cavity 96. With the primary lock member 72 in the primary locked position, the secondary lock member 74 may be arranged (e.g., by gravity) in a secondary locked position (FIG. 5) in which the secondary lock member 74 prevents movement of the primary lock member 72 out of the primary locked position. If a bump or shock causes upward movement of the housing 70 and thus an upward force on the primary lock member 72, the secondary lock member 74 will engage the housing 70 to prevent movement of the primary lock member 72 entirely out of the primary locked position such that access to the hex cavity 68 is still not allowed. When in the secondary locked position, the secondary lock member 74 thus maintains the primary lock member 72 within the primary locked position when subjected to unintentional or intentional bumps or shocks. However, as the bicycle 20 is inverted, the secondary locked member 74 will move from the secondary locked position (FIG. 6) to a secondary unlocked position (FIG. 7) such that continued inversion of the bicycle 20 eventually allows the primary lock member 72 to move from the primary locked position to the primary unlocked position as described above. The intersection location and angle defined by the primary and secondary axes A and B are selected to require the secondary lock member 74 to move with rotation or inversion of the housing 70 from the secondary locked position to the secondary unlocked position before the primary lock member 76 is allowed to move from the primary locked position to the primary unlocked position.

The example tertiary lock member 76 is threaded into the threaded hole 98 for movement along the primary axis A. With the primary lock member 72 in the primary locked position and the secondary lock member 74 in the secondary locked position, the tertiary lock member 76 may be axially rotated for displacement into a tertiary locked position (FIG. 5) in which the tertiary lock member 76 prevents movement of the secondary lock member 74 out of the secondary locked position. The tertiary lock member 76 embodied as a conventional set screw is axially rotated using a screw driver or the like to move the tertiary lock member 76 from the tertiary locked position (FIG. 5) to a tertiary unlocked position (FIG. 6). When tightened into the tertiary locked position, the tertiary lock member 76 positively holds the secondary lock member 74 in the secondary locked position and, in turn, the primary lock member 72 in the primary locked position. When backed away from the tertiary locked position into the tertiary unlocked position, the secondary lock member 74 may move from the secondary locked position into the secondary unlocked position as described above.

As mentioned above, both the secondary lock member 74 and the tertiary lock member 76 are optional, and at least a portion of the benefit of the first example skewer assemblies 50, 52, and 54 may be obtained without the use of the

secondary and/or tertiary lock members **74** and **76**. In addition, the first example skewer assemblies **50**, **52**, and **54** may be constructed with the tertiary lock member **76** and without the secondary lock member **74**. In this case, the tertiary lock member **74** directly engages the primary lock member **72** instead of engaging the primary lock member **72** through a secondary lock member.

II. Second Example Skewer Assembly

FIG. **9** illustrates a second example bicycle **120** comprising a frame assembly **122**, a front wheel assembly **124**, and a rear wheel assembly **126**. As is conventional, the frame assembly **122** comprises a main frame **130** and a fork **132** and the fork comprises at least one blade **134**. As with each of the blades **34** described above, each blade **134** defines a drop out (not shown) defining an axle notch (not shown). A similar drop out and axle notch are formed in the main frame **130** for the rear wheel assembly **126**. The example wheel assemblies **124** and **126** each comprise a hub **140**, spokes **142**, a rim **144**, and a tire **146**. The spokes **142** extend between the hub **140** and rim **144**, and the rim **144** supports the tire **146**. The frame assembly **122** and wheel assemblies **124** and **126** are or may be conventional and will not be described in detail beyond what is helpful for a complete understanding of the present invention.

FIG. **9** further illustrates that a front skewer assembly **150** connects the front wheel assembly **124** to the fork **132**, that a rear skewer assembly **152** connects the rear wheel assembly **126** to the main frame **130**, and that a seat skewer assembly **154** engages a clamp structure **156** for clamping a seat post **158** relative to the main frame **130**. The front, rear, and seat skewer assemblies may be similar or different. The example front, rear, and seat skewer assemblies **150**, **152**, and **154** are all the same and embody a second example skewer assembly of the present invention. For brevity, only the front skewer assembly **150** and the engagement of the skewer assembly **150** with the fork **132** will be described herein in detail. One of ordinary skill in the art will understand that the rear skewer assembly **152** will engage the drop out in the main frame **130** and that the seat skewer assembly **154** will compress portions of the clamp structure **156** in a manner similar to the manner in which the front skewer assembly **152** engages the fork **132**.

FIG. **11** illustrates that the example front skewer assembly **150** comprises or incorporates a conventional quick release axle mechanism comprising a lever **160**, an axle bolt (not shown in FIG. **11** for clarity), a lever pivot **162**, and a lock assembly **164**. The example quick release skewer assembly **150** is referred to as an open style quick release. The example seat skewer assembly **154** will include a clamp bolt instead of an axle bolt, and the clamp bolt will typically be sized and dimensioned for the particular clamp structure **156** defined by the example bicycle **120**.

The example lever **160** defines a pivot opening **166** and a lock opening **168**. FIG. **11** illustrates that the example lock assembly **164** comprises a housing **170** and a primary lock member **172**. The example primary lock member **172** is a cylindrical member. The example lock opening **168** is cylindrical and has a diameter slightly larger than that of the primary lock member **172**. The use of the lever **160**, axle bolt, and lever pivot **162** to secure a wheel assembly to a bike frame is well-known and will not be described herein in detail beyond what is helpful for a complete understanding of the present invention.

Optionally, the example lock assembly **164** may also optionally be provided with a secondary lock member **174**

and a tertiary lock member **176**. The example secondary lock member **174** is a sphere or ball, and the example tertiary lock member **176** is a set screw. In this example, a diameter of a sphere forming the example secondary lock member **174** is smaller than a diameter of a cylindrical member forming the example primary lock member **172**. The example housing **170** comprises a housing base **180** and a housing cap **182**. At least one base projection (not shown) such as the base projections **84a** and **84b** described above extends from the housing base **180** to engage a portion of the fork **132** such that an orientation of the housing **170** is predetermined relative to an orientation of the bicycle **20**. A lever notch **186** is formed in the example housing cap **182**. When the housing base **180** and housing lid **182** are secured together, a first pivot cavity **188a** is formed in the housing base **180**, and a second pivot cavity **188b** is formed in the housing cap **182**.

When the housing base **180** and housing lid **182** are secured together, the example housing **170** defines a through hole **190**, a first primary cavity **192**, a second primary cavity **194**, a secondary cavity **196**, and a threaded hole **198**. The example through hole **190** is cylindrical. The primary cavities **192** and **194** are at least partially cylindrical and are aligned along a primary axis A that extends at a right angle to the axis of the through hole **190**. A diameter of the example first and second primary cavities **192** and **194** is slightly larger than the diameter of the primary lock member **172**. The secondary cavity **196** defines a secondary axis B that is coplanar with and intersects the primary axis A at an intersection angle. The diameter of the example secondary cavity **196** is slightly larger than a diameter of the example secondary lock member **174**. The diameter of the example secondary lock member **174** is, however, larger than a diameter of the primary cavities **192** and **194** so that the secondary lock member **174** may not move within the primary cavity **194** along the primary axis A. The threaded hole **198** is aligned with the primary axis A.

In use, the axle bolt is arranged to extend through the through hole **190** and through a skewer opening **162a** in the lever pivot **162**. The lever pivot **162** extends through the pivot opening **166** in the lever **160** and is supported by the first and second pivot cavities **188a** and **188b** to support the lever **160** for pivoting movement relative to the housing **170**. The lever **160** otherwise engages the axle nut (not shown) in a conventional manner.

The example primary lock member **172** is arranged for sliding movement within the first and second primary cavities **192** and **194**. When held in a primary locked position (e.g., by gravity) as shown in FIG. **15**, the primary lock member **172** lies within the first and second primary cavities **192** and **194**. With the lever **160** is in a tightened position as shown in FIGS. **13-17** and the lock housing **170** is upright (e.g., upright orientation), the primary lock member **172** also extends through the lock opening **168** in the lever **160** to prevent movement of the lever **160** relative to the housing **170**. However, as shown for example in FIGS. **16** and **17**, rotating or at least partly inverting the housing **170** (e.g., displacing from upright orientation) allows the primary lock member **172** to be moved (e.g., by gravity) from the primary locked position (FIG. **16**) to a primary unlocked position (FIG. **17**). In the primary unlocked position, the primary lock member **172** moves out of the lock opening **166** to allow normal pivoting movement of the lever **160** from the tightened position (e.g., FIG. **17**) to a loosened position (FIG. **18**). As is conventional, with the lever **160** in the loosened position, the wheel assembly **124** may be removed from the fork **132**.

Accordingly, by at least partly inverting the bicycle **120** and thus the housing **170**, the lever **160** may be rotated or pivoted from the tightened position to the loosened position to loosen the front skewer assembly **150** and thus allow removal of the front wheel assembly **124** from the fork **132**. If the bicycle **120** cannot be inverted for some reason (e.g., chained to a bike rack), the primary lock member **172** prevents rotation of the lever **160** and thus inhibits removal of the front wheel assembly **124**.

The example secondary lock member **174** is arranged for rolling movement within the secondary cavity **196**. With the primary lock member **172** in the primary locked position, the secondary lock member **174** may be arranged (e.g., by gravity) in a secondary locked position (FIG. **15**) in which the secondary lock member **174** prevents movement of the primary lock member **172** out of the primary locked position. If a bump or shock causes upward movement of the housing **170** and thus an upward force on the primary lock member **172**, the secondary lock member **174** will prevent movement of the primary lock member **172** entirely out of the primary locked position such that rotation of the lever **160** still not allowed. When in the secondary locked position, the secondary lock member **174** thus maintains the primary lock member **172** within the primary locked position when subjected to unintentional or unintentional bumps or shocks. However, as the bicycle **120** is inverted, the secondary locked member **174** will move from the secondary locked position (FIG. **15**) to a secondary unlocked position (FIG. **16**) and eventually allow the primary lock member to move from the primary locked position to the primary unlocked position as described above. The intersection angle defined by the primary and secondary axes A and B is selected to require the secondary lock member **174** to move with rotation or inversion of the housing **170** from the secondary locked position to the secondary unlocked position before the primary lock member **172** is allowed to move from the primary locked position to the primary unlocked position.

The example tertiary lock member **176** is threaded into the threaded hole **198** for movement along the primary axis A. With the primary lock member **172** in the primary locked position and the secondary lock member **174** in the secondary locked position, the tertiary lock member **176** may be axially rotated for displacement into in a tertiary locked position (FIG. **14**) in which the tertiary lock member **176** prevents movement of the secondary lock member **174** out of the secondary locked position. The tertiary lock member **176** embodied as a conventional set screw is axially rotated using a screw driver or the like to move the tertiary lock member **176** from the tertiary locked position (FIG. **14**) to a tertiary unlocked position (FIG. **15**). When tightened into the tertiary locked position, the tertiary lock member **176** positively holds the secondary lock member **174** in the secondary locked position and, in turn, the primary lock member **172** in the primary locked position. When backed away from the tertiary locked position into the tertiary unlocked position, the secondary lock member **174** may move from the secondary locked position into the second unlocked position as described above.

As mentioned above, both the secondary lock member **174** and the tertiary lock member **176** are optional, and at least a portion of the benefit of the second example skewer assemblies **150**, **152**, and **154** may be obtained without the use of the secondary and/or tertiary lock members **174** and **176**. In addition, the second example skewer assemblies **150**, **152**, and **154** may be constructed with the tertiary lock member **176** and without the secondary lock member **174**. In

this case, the tertiary lock member **176** directly engages the primary lock member **172** instead of engaging the primary lock member **172** through a secondary lock member.

III. Third Example Skewer Assembly

Referring now to FIGS. **19-23** of the drawing, depicted therein is a third example skewer assembly **220** constructed in accordance with, and embodying, the principles of the present invention. FIG. **19** illustrates that the third example skewer assembly **220** is similar to the first example skewer assembly forming the skewer assemblies **50**, **52**, and **54** but employs a slip nut assembly **222** instead of a conventional nut such as the axle nut **62** described above.

The third example skewer may be used in place of any of the skewer assemblies **50**, **52**, **54**, **150**, **152**, and **154** described above. Alternatively, the slip nut assembly **22** may be used instead of the conventional nut forming part of the second example skewer assembly forming the skewer assemblies **150**, **152**, and **154**. The third example skewer assembly **220** will be described herein only to the extent that it differs from the first example skewer assembly forming the skewer assemblies **50**, **52**, and **54**.

The example slip nut assembly **222** comprises a nut housing **230**, a drive member **232**, a nut member **234**, a biasing member **236**, and a retaining ring **238**. The nut housing **230** defines a nut axis N.

The example nut housing **230** defines first and second wall inner surfaces **240** and **242** defining a housing cavity **244** and an outer wall surface **246**. At least a portion of the first inner wall surface **240** defines a first diameter that is smaller than a second diameter of the second inner wall **242** such that an annular wall surface **248** extends between the first and second inner wall surfaces **240** and **242**. A plurality of drive recesses **250** are formed in the inner surfaces **240** and **242**. The example nut housing **230** defines two of the drive recesses **250** arranged on opposing sides of and generally extend parallel to the nut axis N.

The example drive member **232** defines a side surface **260**, a first end surface **262**, and a second end surface **264**. A plurality of first drive projections **266** extend from the side surface **260**, and a plurality of second drive projections **268** extend from the first end surface **262**. The example drive member **232** defines two of the first drive projections **266**, and the example first drive projections **266** are arranged on opposing sides of the drive member **232**. The example drive member **232** defines four of the second drive projections **268** on the first end surface **262**. The example drive projections **268** are spaced 90 degrees from each other about a longitudinal axis of the drive member **232**.

The example nut member **234** defines an inner end surface **270** and an outer end surface **272**. A threaded opening **274** is formed in the outer end surface **272**, and a plurality of drive grooves **276** are formed in the inner end surface **270**. The example threaded opening **274** is aligned with a longitudinal axis of the nut member **234**. The example nut member **234** defines four of the drive grooves **276**, and the example drive grooves **276** are spaced 90 degrees from each other about the longitudinal axis of the nut member **234**.

The example biasing member **236** is a compression spring, but any structure capable of applying a biasing force as described may be used as the biasing member **236**.

The example retaining ring **238** defines first and second wall surfaces **280** and **282**. The second wall surface **282** defines a ring opening **284**.

The example slip nut assembly **222** is assembled as follows. The biasing member **236** is arranged within the

housing cavity 244. The drive member 232 is arranged within the housing cavity 244 such that the drive recesses 250 receive the first drive projections 266 and the second end surface 264 are in contact with the biasing member 236. The nut member 234 is arranged with the inner end surface 270 arranged such that the second drive projections 268 on the drive member 232 are received by the drive grooves 276 in the nut member 234. The retaining ring 238 is then arranged such that the first wall surface 280 thereof engages the second inner wall surface 242 on the example nut housing member 230. The longitudinal axes of the drive member 232, the nut member 234, the biasing member 236, and the retaining ring 238 are all substantially coaxially aligned with the nut axis N. At this point, the threaded opening 274 in the nut member 234 is accessible through the ring opening 284 defined by the retaining ring 238.

Once assembled, the example slip nut assembly 222 is used as follows. In the third example skewer assembly 220, the axle bolt 60 is inserted through the wheel hub and arranged within the dropouts 38 in a conventional manner. The slip nut assembly 222 is then arranged such that the threaded opening 274 receives the threaded end of the axle bolt 60. Rotation of the nut housing 230 is transferred by the drive recesses 250 within the nut housing 230 to the first drive projections 266 on the drive member 232 such that the axial rotation of the nut housing 230 is transferred to the drive member 232.

Initially, the biasing member 236 applies a biasing force to the drive member 232 that forces the drive member towards the nut member 234 such that the drive grooves 276 in the nut member 234 receive the second drive projections 268 on the drive member 232 as shown in FIG. 22. With the drive grooves 276 received by the second drive projections 268, axial rotation of the drive member 232 is transferred to the nut member 234. The axle bolt 60 may thus be threaded at least partly into the threaded opening 274 by manual axial rotation of the nut housing 230.

At a certain point, resistance of the threading of the axle bolt 60 into the threaded opening 274 will increase to a point at which the biasing force applied by the biasing member 236 onto the drive member 232 will be insufficient to maintain the second drive projections 268 within the drive grooves 276. At this point, drive projections 268 will come out of the drive grooves 276 as shown in FIG. 23. After the threading resistance reaches a predetermined threshold, continued rotation of the nut housing 230 will simply cause the drive member 232 to rotate relative to the nut member 234 within the housing cavity 244 without causing rotation of the nut member 234. Instead, in the example slip nut assembly 222, the drive member 232 will slip over the nut member 234, causing a click sound as the drive projections 268 move out of and then reseat into the drive grooves 276 during each quarter turn of the nut housing 230.

Accordingly, the example slip nut assembly 222 allows the nut member 234 to be only partly tightened onto the axle bolt 60. The axle bolt 60 may only be fully tightened by engaging a tool with the hex cavity 68 on the other end of the axle bolt 60 from the slip nut assembly 222. If the slip nut assembly 222 is used with the second example skewer assemblies 150, 152, or 154, the bolt may only be fully tightened by operating the lever 160. And once the axle bolt 60 is tightened, the axle bolt 60 may not be removed using the slip nut assembly 222. The third example skewer assembly 220 may thus be removed under normal circumstances by inverting the skewer assembly 220 such that the lock assembly 64 thereof is displaced to allow access to the hex

cavity 68 or, in the case of the second example type of skewer assembly, by operating the lever 160.

The example drive projections 268 each define at least one angled surface 290, and the example drive grooves 276 each define at least one angled surface 292. The angle surfaces 290 and 292 are complementary such that threading resistance created by the engagement of the axle bolt 60 with the threaded opening 274 results in a linear force on the drive member 232 that opposes the biasing force applied by the biasing member 236. In the example slip nut assembly 222, the angle of the angled surfaces 290 and 292 and the bias force applied by the resilient member 236 are selected such that nut member 234 may be partly threaded onto the axle bolt 60 but, once the axle bolt 60 is tightened as described above, the nut member 234 may not be rotated to allow the skewer assembly 220 to be removed.

IV. Fourth Example Skewer Assembly

Referring now to FIGS. 24-28 of the drawing, depicted therein is a fourth example skewer assembly 320 constructed in accordance with, and embodying, the principles of the present invention. The fourth example skewer type may be used in place of any of the skewer assemblies 50, 52, 54, 150, 152, and 154 described above.

FIG. 24 illustrates that the fourth example skewer assembly 320 employs a slip nut assembly 322 similar to the slip nut assembly 222 described above. The slip nut assembly 322 may be the same or similar to the example slip nut assembly 222 and will not be described herein in detail. Alternatively, a conventional axle nut may be used in place of the example slip nut assembly 222.

The fourth example skewer assembly 320 is generally similar to the second type of skewer assembly embodied in the skewer assemblies 150, 152, and 154 described above in that it incorporates a conventional quick release axle mechanism but employs what will be referred to herein as a closed lever action to tighten the skewer assembly 320.

As shown in FIGS. 24 and 25, the example skewer assembly 320 comprises a lever 330, an axle bolt 332, and a lock assembly 334. The example quick release skewer assembly 330 is referred to as closed style quick release. If used as a seat skewer assembly, the example skewer assembly 330 will include a clamp bolt instead of an axle bolt, and the clamp bolt will typically be sized and dimensioned for a particular clamp structure.

FIG. 24 illustrates that the example lock assembly 334 comprises a housing 340. The example lever 330 further defines a pivot portion 342 and a cam portion 344. The pivot portion 342 is contained within and engages the housing 340 such that rotation of the lever 330 causes offset rotation of the cam portion 344 about an axis of rotation of the pivot portion 342. The cam portion 344 is in turn connected to the axle bolt 332 such that offset rotation of the cam portion 344 causes displacement of the axial bolt 332 along its longitudinal axes. The use of the lever 330 to displace the axle bolt 332 is well-known and will not be described herein in further detail.

FIG. 25 illustrates that the lock assembly 334 further comprises a primary lock member 350. The example primary lock member 350 is a cylindrical member. A lock opening 352 is formed in the lever 330. The example lock opening 352 is cylindrical and has a diameter slightly larger than that of the primary lock member 350. The example lock assembly 334 is also optionally provided with a secondary lock member 354. The example secondary lock member 354 is a sphere or ball. The diameter of the example secondary

lock member **354** is smaller than a diameter of the example primary lock member **350**. Although not visible, a tertiary lock member such as a set screw may be used in a manner similar to the tertiary lock member **176** described above.

The example housing **340** comprises a housing base **360** and a housing cap **362**. At least one base projection (not shown) such as the base projections **84a** and **84b** described above extends from the housing base **360** to engage a portion of the fork **132** such that an orientation of the housing **340** is predetermined relative to an orientation of the bicycle **20**.

When the housing base **360** and housing lid **362** are secured together, the example housing **340** defines an axle opening **370**, a primary cavity **372**, a secondary cavity **374**, and, if a tertiary lock member is used, a threaded hole (not visible). A diameter of the example primary cavity **372** is slightly larger than the diameter of the primary lock member **350**. The secondary cavity **374** intersects the primary cavity **372** at an intersection location and intersection angle. The diameter of the example secondary cavity **374** is slightly larger than a diameter of the example secondary lock member **354**. The diameter of the example secondary lock member **354** is, however, larger than a diameter of the primary cavity **372** so that the secondary lock member **354** may not move within the primary cavity **372**.

In use, the axle bolt **332** is arranged partly within the axle opening **370** and such that the cam portion **344** of the lever **330** is within a cam opening **376** formed in a head portion **378** of the axle bolt **332**.

The example primary lock member **350** is arranged for sliding movement within the primary cavity **372**. When held in a primary locked position as shown in FIGS. **25B** and **26B**, typically by gravity when the fourth example skewer system **320** is upright, the primary lock member **350** lies partly within the primary cavity **372**. With the lever **330** in a tightened position as shown in FIGS. **25-26** and the lock housing **340** upright, the primary lock member **350** also extends through the lock opening **352** in the lever **330** to prevent movement of the lever **330** relative to the housing **340**.

However, as shown for example in FIGS. **27** and **28**, rotating or at least partly inverting the housing **340** (typically by inverting the bicycle) allows the primary lock member **350** to be moved (e.g., by gravity) from the primary locked position (FIGS. **25** and **26**) to a primary unlocked position (FIGS. **27** and **28**). In the primary unlocked position, the primary lock member **350** moves out of the lock opening **352** to allow normal pivoting movement of the lever **330** from the tightened position (e.g., FIGS. **25-27**) to a loosened position (FIG. **28**). As is conventional, with the lever **330** in the loosened position, the component (e.g., wheel assembly, seat) may be removed.

Accordingly, by at least partly inverting the bicycle and thus the housing **340**, the lever **330** may be rotated or pivoted from the tightened position to the loosened position to loosen the fourth example skewer assembly **320** and thus allow removal of the component (e.g., wheel assembly, seat). If the bicycle **120** cannot be inverted for some reason (e.g., chained to a bike rack), the primary lock member **350** prevents rotation of the lever **330** and thus inhibits removal of the component (e.g., wheel assembly, seat).

The example secondary lock member **354** is arranged for rolling movement within the secondary cavity **374**. With the primary lock member **350** in the primary locked position, the secondary lock member **354** may be arranged (e.g., by gravity) in a secondary locked position (FIG. **25**) in which the secondary lock member **354** prevents movement of the primary lock member **350** out of the primary locked posi-

tion. If a bump or shock causes upward movement of the housing **340** and thus an upward force on the primary lock member **350**, the secondary lock member **354** will prevent movement of the primary lock member **350** entirely out of the primary locked position such that rotation of the lever **330** still not allowed. When in the secondary locked position, the secondary lock member **354** thus maintains the primary lock member **350** within the primary locked position when subjected to unintentional or unintentional bumps or shocks.

However, as the bicycle **120** is inverted, the secondary locked member **344** will move from the secondary locked position (FIG. **25**) to a secondary unlocked position (FIGS. **26-28**) and eventually allow the primary lock member to move from the primary locked position to the primary unlocked position as described above. The intersection angle defined by the primary and secondary cavities **372** and **374** is selected to require the secondary lock member **354** to move with rotation or inversion of the housing **340** from the secondary locked position to the secondary unlocked position before the primary lock member **346** is allowed to move from the primary locked position to the primary unlocked position.

What is claimed is:

1. A skewer assembly for securing a component to a first portion of a bicycle comprising:

a bolt for detachably attaching the component to the first portion of the bicycle;

a housing supported relative to the bolt;

a first lock member supported for movement relative to the housing; and

a second lock member supported for movement relative to the housing; wherein

when the skewer assembly is in an upright orientation, gravity acts on

the second lock member such that the second lock member inhibits movement of the first lock member, and

the first lock member such that the first lock member is arranged relative to the housing to inhibit tightening of the bolt; and

when the skewer assembly is at least partly displaced from the upright orientation, gravity displaces

the second lock member to allow movement of the first lock member, and

the first lock member to allow tightening of the bolt.

2. A skewer assembly as recited in claim 1, in which the skewer assembly is at least partly inverted to displace the skewer assembly at least partly from the upright orientation.

3. A skewer assembly as recited in claim 1, in which:

the bolt defines a head portion; and

the first lock member inhibits access to the head portion of the bolt when the skewer assembly is in the upright orientation; and

the first lock member allows access to the head portion of the bolt when the skewer assembly is sufficiently displaced from the upright orientation.

4. A skewer assembly as recited in claim 1, further comprising a lever operatively configured to tighten the bolt, in which:

the first lock member inhibits movement of the lever when the skewer assembly is in the upright orientation; and

the first lock member allows movement of the lever when the skewer assembly is sufficiently displaced from the upright orientation.

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5. A skewer assembly as recited in claim 1, in which, when the skewer assembly is displaced from at least partly out of the upright orientation into the upright orientation, gravity displaces

the first lock member to inhibit tightening of the bolt; and
the second lock member to inhibit movement of the first lock member.

6. A skewer assembly as recited in claim 1, further comprising a third lock member, where the third lock member is supported by the housing such that

when the skewer assembly is in an upright orientation, the third lock member inhibits movement of the first lock member; and

when the skewer assembly is at least partly displaced from the upright orientation, the second lock member is displaced to allow movement of the first lock member.

7. A skewer assembly as recited in claim 1, further comprising a slip nut assembly comprising:

a housing;

a drive member;

a nut member; and

a biasing member; whereby

the nut member engages the bolt; and

the biasing member is arranged to apply a biasing force on the drive member such that rotation of the housing is transmitted to the nut member through the drive member when threading resistance between the nut member and the bolt is below a predetermined threshold.

8. A skewer assembly as recited in claim 1, in which: the component is at least one of a wheel and a seat; and the first portion of the bicycle is at least one of a fork and a frame of the bicycle.

9. A skewer assembly as recited in claim 1, further comprising a base projection extending from the housing, where the base projection engages at least a second portion of the bicycle to inhibit rotation of the housing relative to the first portion of the bicycle.

10. A method of securing a component to a portion of a bicycle comprising the steps of:

providing a bolt for detachably attaching the component to the portion of the bicycle;

supporting a housing relative to the bolt;

supporting a first lock member with the housing for movement relative to the housing;

supporting a second lock member for movement relative to the housing;

arranging the bicycle to place the housing in an upright orientation such that gravity acts on

the second lock member such that the second lock member inhibits movement of the first lock member, and

the first lock member is positioned relative to the housing to inhibit tightening of the bolt; and

arranging the bicycle to displace the housing at least partly out of the upright orientation such that gravity displaces

the second lock member relative to the housing to allow movement of the first lock member, and

the first lock member relative to the housing to allow tightening of the bolt.

11. A method as recited in claim 10, in which the step of displacing the housing at least partly from the upright orientation comprises the step of at least partly inverting the housing.

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12. A method as recited in claim 10, in which:

the bolt defines a head portion; and

the first lock member inhibits access to the head portion of the bolt when the housing is in the upright orientation; and

the first lock member allows access to the head portion of the bolt when the housing is sufficiently displaced from the upright orientation.

13. A method as recited in claim 10, further comprising the step of operatively configuring a lever to tighten the bolt, in which:

the first lock member inhibits movement of the lever when the housing is in the upright orientation; and

the first lock member allows movement of the lever when the housing is sufficiently displaced from the upright orientation.

14. A method as recited in claim 10, further comprising the step of:

arranging the bicycle to displace the housing from at least partly out of the upright orientation into the upright orientation such that gravity displaces

the first lock member relative to the housing to inhibit tightening of the bolt, and

the second lock member relative to the housing to inhibit movement of the first lock member.

15. A method as recited in claim 10, further comprising the step of supporting a third lock member with the housing such that:

when the housing is in an upright orientation, the third lock member inhibits movement of the first lock member; and

when the housing is at least partly displaced from the upright orientation, the second lock member is displaced to allow movement of the first lock member.

16. A method as recited in claim 15, in which the third lock member engages the second lock member to inhibit movement of the first lock member.

17. A bicycle assembly comprising:

a frame;

a fork;

a front wheel;

a rear wheel;

a seat;

a first bolt for detachably attaching the front wheel to the fork;

a second bolt for detachably attaching the rear wheel to the frame;

a third bolt for detachably attaching the seat to the frame; at least one housing supported relative to at least one of the first bolt, the second bolt, and the third bolt;

a first lock member supported for movement relative to the at least one housing; and

a second lock member, where the second lock member is supported for movement relative to the housing such that; wherein

when the bicycle assembly is in an upright orientation, gravity acts on

the second lock member such that the second lock member inhibits movement of the first lock member, and

the first lock member such that the first lock member inhibits tightening of the bolt; and

when the bicycle assembly is at least partly displaced from the upright orientation, gravity displaces

the second lock member to allow movement of the first lock member, and

the first lock member to allow tightening of the bolt.

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18. A housing as recited in claim **17**, in which:
when the bicycle assembly is displaced from at least
partly out of the upright orientation into the upright
orientation, gravity displaces
the first lock member to inhibit tightening of the bolt, 5
and
the second lock member to inhibit movement of the
first lock member.

19. A housing as recited in claim **18**,
further comprising a third lock member, where the third 10
lock member is supported by the housing such that
when the bicycle assembly is in an upright orientation, the
third lock member inhibits movement of the first lock
member; and
when the bicycle assembly is at least partly displaced 15
from the upright orientation, the second lock member is
displaced to allow movement of the first lock member.

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